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Supplement to

GUIDE TO AUTHORS OF MANUSCRIPTS FOR PUBLISHED SOIL SURVEYS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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This supplement has been prepared for use along with the latest revisions of the Guide to Authors of Published Soil Surveys and the Annotated Checklist. Study these documents and several of the latest published surveys before you start to write your soil survey manuscript.

This supplement contains the latest prewritten material for use in writing soil survey manuscripts. Also, it contains outlines and examples of the main parts of the manuscript. The yellow sheets contain instructions, suggested outlines and other helpful information. The white sheets are mainly prewritten material that you can use with slight adjustment. The blue sheets are examples that have been edited and that illustrate acceptable format.

FRONT COVER

Use this style of front cover and fill in the blanks. Get a good photo to use on the cover of the published soil survey.

HOW TO USE THIS SOIL SURVEY

Read this material carefully. Delete the parts that do not apply to your county and make other necessary adjustments. The caption for the cover photo will be placed on the bottom of this page. It must tell something significant about the soils named in the picture.

HOW THE SURVEY WAS MADE

Fill in the blanks. If you have only monophase soil series in your survey area, or if you do not have a soil complex, or a land type, the writeup will need adjusting. In the last two paragraphs of the last page, some adjustments may be needed to fit your survey.

GENERAL SOIL MAP

Use this writeup as an introduction to the descriptions of the soil associations. Delete appropriate parts of the third paragraph unless the legend for the general soil map has the soil associations grouped.

DESCRIPTIONS OF THE SOILS

Fill in the blanks and use this writeup to introduce the section. If interpretations for field crops and tame pasture are included with descriptions of mapping units this introduction must so state.

USE AND MANAGEMENT OF THE SOILS

Begin this section with a short introduction that tells what is in the section.

Start the subsection, "Use and Management of Soils for Crops and Tame Pasture," with a short introduction. In it tell how much of the county is

used for cropland, what crops are grown, and the management practices that can be used in the county. Be brief in discussing general principles of soil management and avoid long discussions about the value of certain practices. The discussion of general principles of soil management might briefly mention the need for lime and fertilizer, maintenance of organic matter, drainage and erosion control practices, and pasture management. There will then be no need to discuss these practices for all of the capability units. If it is important to emphasize the use of one or more specific practices, consider suggesting them for all soils suited to field crops and tame pasture.

In the writeup, "Capability Groups of Soils," if no soil in your county is in a capability class, keep the definition and after it add "(none in the county)."

Soil-Woodland interpretations should be made either in tabular form or in a narrative. Do not have the same information given in both forms. If you choose to use the narrative style, give Woodland Suitability Groups in a format similar to Capability Units. See Memorandum SCS-26, revised.

Wildlife interpretations can be made by individual soils according to their suitability for various kinds of plants and other elements that make up wildlife habitat.

To prepare the "Engineering Uses of Soils," follow Soils Memorandum SCS-45 and the "Guide for Interpreting Engineering Uses of Soils."

General statements about use and management of soils and general statements about management of crops, trees, grass, and wildlife that are not related to named kinds of soil on the soil map will not be included in soil survey manuscripts. The same principle about general statements unrelated to kinds of soils and their use applies to other items discussed in the manuscript. Photos of landscapes taken outside the county and photos having captions that do not relate the picture to specific kinds of soil will be eliminated. Engineering and agronomic specifications (such as pounds of fertilizer and specific rotations) should not be given in manuscripts.

FORMATION AND CLASSIFICATION OF SOILS

Begin this section with an introduction telling what is in the section. Follow this with the introduction, "Factors of Soil Formation."

In the discussions of the five soil-forming processes, relate how these processes have influenced the formation of the soils in your county. Avoid "text-book" discussions that would apply to soil formation everywhere.

Adjust the writeup, "Classification of the Soils," to fit the soils in your county. The discussion of the orders will require the greatest adjustment.

Checklists

The two forms that follow are used in writing and checking soil survey manuscripts.

The "Checklist for Some Soil Properties" is designed to show those properties (given in the soil descriptions) that are also given in the interpretive parts of the manuscript; such as, soil associations, capability units, woodland groups, engineering tables, and tables of limitations for nonfarm uses.

Since the entries are to be identical with those in the soil descriptions section (and in agreement with the standard series description), it saves thumbing through the manuscript for consistence. A blank space would show that property was not given in the soil description. It helps keep the information uniform.

The column headings can be adjusted to fit conditions in any state. We have found that it makes the checking for consistence quicker and easier. Other specialists also find that the information in the checklist is helpful.

The "Checklist of Terminology" contains the terms used for the various soil properties. This page is used to obtain proper terms in the manuscript. One blank column is to be filled in with the percent slope of the slope groups used in the survey area. If soils are correlated with wider slope groups, the adjective terms that cover the range are used. Abbreviations have been used in the checklist of terminology because of lack of space. Do not use abbreviations in your manuscript.

We ask that each copy of the manuscript contain a copy of these two checklists. Reviewers and editors have told us it helps them in their work. In addition to the many dollars saved in time spent in checking the manuscript, the author will discover that he can avoid the embarrassment of having reviewers listing the many inconsistencies encountered when the checklist is not used.

CHECKLIST OF TERMINOLOGY USED IN SOIL SURVEY OF _____ COUNTY, _____ (State)

(Sheet #1)

Slope		
	Descriptive Terms	
Percent	Simple	Complex
	Nearly level	Nearly level
	Gently sloping	Undulating
	Sloping	Rolling
	Mod. steep	Hilly
	Steep	Steep
	Very steep	Very steep

Permeability	
Inches/Hour	Class
< 0.06	Very slow
0.06-0.2	Slow
0.2-0.6	Mod. slow
0.6-2.0	Moderate
2.0-6.3	Mod. rapid
> 6.3	Rapid

Organic Matter	
Percent	Adjective
< 2.0	Low
2.0-4.0	Moderate
> 4.0	High

Natural Fertility
High
Medium
Low

Runoff
Ponded
Very slow
Slow
Medium
Rapid
Very rapid

Soil Textural Classes		
Basic Class Names	General Terms	
Sands	Coarse-textured soils	Sandy soils
Sandy loam Fi.sa.loam	Moderately coarse textured soils	
v.fi.sa.loam loam silt loam silt	Medium-textured soils	Loamy soils
clay loam sa.cl.loam si.cl.loam	Moderately fine textured soils	
sandy clay silty clay clay	Fine textured soils	Clayey soils

Available Water Capacity	
In/40" Profile*	Class
0-1.8	Very low
1.8-2.4	Low
2.4-3.9	Moderate
3.9+	High

*or to limiting layer--soils less than 40" to bedrock or pan rate no higher than moderate.

Soil Reaction	
Term	pH
Extremely acid	< 4.5
V. str. acid	4.5-5.0
Strongly acid	5.1-5.5
Medium acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Mildly alkaline	7.4-7.8
Mod. alkaline	7.9-8.4
Str. alkaline	8.5-9.0
V.str. alkaline	>9.0

Drainage
Very poorly
Poorly
Somewhat poorly
Moderately well
Well
Somewhat excess.
Excessively

CHECKLIST FOR SOME SOIL PROPERTIES FOR SOILS OF_____County,_____(State)

(Sheet #2)

	Soil Series	Depth	Dominant Texture		Drainage	Permeability	Available Water Capacity	Organic Matter	Fertility	
			Surface	Subsoil						

SUGGESTED MAJOR OUTLINE
FOR
SOIL SURVEY MANUSCRIPTS

1. Introductory section

   A. Front cover
   B. How to use this soil survey
   C. Table of contents
   D. Half-title page
   E. Introduction
   F. How the survey was made

2. General soil map

   A. Introduction
   B. General soil map and legend (in back of report)
   C. Soil associations

3. Descriptions of the soils

   A. Introduction
   B. Acreage and proportionate extent table
   C. Descriptions by series and mapping units

4. Use and management of the soils

   A. Introduction
   B. Use and management of soils for crops and tame pasture

      1) Introduction

         a. Percent of county in cropland
         b. Crops grown
         c. Management problems

      2) Capability groups of soils

         a. Introduction
         b. General principles of soil management
         c. Management of capability units

      3) Predicted yields

         a. Levels of management
         b. Table of yields

   C. Use of soils for woodland

      1) Introduction
      2) Explanation of woodland grouping
      3) Management by woodland groups

D. Use of soils for wildlife

1) Introduction
2) Explanation of suitability ratings, habitat elements, and classes of wildlife
3) Suitability ratings by individual soils (in tabular form)

E. Use of soils for recreational purposes

1) Introduction
2) Explanation of limitations
3) Limitations for use (usually in tabular form)

F. Engineering uses of soils
(See Soils Memorandum SCS-45 and Guide for Interpreting Engineering Uses of Soils)

1) Introduction
2) Uses of the information
3) Soil science terminology
4) Explanation of tables
5) Tables of estimated properties, interpretations and test data

G. Uses of the soils for town and country planning

1) Introduction
2) Explanation of table
3) Limitations for use in tabular form

5. Formation, morphology, and classification of the soils

A. Introduction
B. Factors of soil formation

1) Introduction
2) Parent material
3) Climate
4) Plant and animal life
5) Relief
6) Time

C. Morphology of the soils

1) Major soil horizons (optional).
2) Processes of soil horizon differentiation

D. Classification of the soils

1) Explanation
2) Classification in tabular form

6. Environmental factors affecting soil use in the survey area

   A. Introduction
   B. Climate
   C. Relief and drainage
   D. Farming
   E. Transportation and markets
   F. Water supply

7. Glossary of terms
8. Literature cited
9. Guide to mapping units

SOIL SURVEY

SOIL SURVEY OF

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

In cooperation with

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Issued----------19

Major fieldwork for this soil survey was done in the period 19 . Soil names and descriptions were approved in 19 . Unless otherwise indicated, statements in the publication refer to conditions in the county in 19 . This survey was made cooperatively by the Soil Conservation Service and the
It is part of the technical assistance furnished to the

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic-Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that effect the choice of sites for dwellings, industrial buildings and for recreation areas in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in _____ County (Area) may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given* at the beginning of the publication.

Cover:

*use if appropriate:

....in the section "General Nature of the County."

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SOIL SURVEY OF DAUPHIN COUNTY, PENNSYLVANIA

BY MERRILL W. KUNKLE, GARLAND H. LIPSCOMB, AND RICHMOND KINNARD, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE PENNSYLVANIA STATE UNIVERSITY, AGRICULTURAL EXPERIMENT STATION AND AGRICULTURAL EXTENSION SERVICE, AND THE PENNSYLVANIA DEPARTMENT OF AGRICULTURE, STATE SOIL AND WATER CONSERVATION COMMISSION

Outline for Introduction to a Published Soil Survey

Use of an outline for this short section will not insure that the author can follow it and prepare a good introduction for a survey. Some of the general facts relating to the survey area that will be helpful to readers will be provided, however, if the subjects listed below are followed:

1. Location and extent of the survey area. Discuss this briefly because the map in figure 1 should show location adequately.

2. Give approximate population of the survey area and tell how most of the populace makes a living.

3. Give the proportion of the survey area that is in farms, woodlands, or other uses. Discuss kinds of farms or woodlands.

4. Discuss orchards and truck crops if those are particularly significant to the economy of the survey area or if they are likely to become important.

5. Briefly discuss physiographic features and their relations to soils.

6. Briefly discuss the dominant soils in one, two, or three groups, as appropriate, and give their special needs in management.

7. Discuss potential uses of soils other than those now widely practiced.

KENT COUNTY is the central one of the three counties in Delaware (fig. 1). It has an area of 380,800 acres (595 square miles of land) and 2,560 acres of water. Dover, in the north-central part of the county, is the largest town. It is the county seat and also the capital city of Delaware. The Dover Air Force Base, covering an area of 3,585 acres, was not surveyed. Other important towns are Harrington, Milford, and Smyrna. There are a number of small towns and villages.

Most of the soils of the county are well suited to a wide variety of uses, both farm and nonfarm. The main exceptions are the marshy tidal areas that border Delaware Bay. About 88 percent of the land area is suitable for cultivation. Most of the rest is made up of marshes and beaches.

Improvement of natural drainage is the chief overall problem in soil management. About 48 percent of the land area needs some degree of artificial drainage before it can be used extensively for farming. About 22 percent is subject to erosion, but the hazard of erosion is severe only in rather small areas. About 6 percent is moderately to severely limited by sandiness and low available moisture capacity. About 12 percent consists of soils that have few, if any limitations for farming and need no special management. The remaining 12 percent is not suitable for farming.

The climate of the county is favorable for general farming, for raising poultry and livestock, and for growing truck crops, small fruits, orchard fruits, and woodland products. According to the 1964 Census of Agriculture, the most important farm products are general or field crops, dairy products, poultry and poultry products, truck crops, livestock and livestock products, and fruit crops, in that order. Soybeans are the most extensively planted general crop, followed in order by corn, hay, wheat, barley, rye, and oats. The most important truck crops are Irish potatoes, lima beans, peas, asparagus, sweet corn, and tomatoes. Orchards and vineyards are important locally.

Kent County is exceptionally well located in relation to markets for farm products. Wilmington, the largest city in the State, is a substantial market, and Philadelphia, Baltimore, Washington, and New York are within reasonable distances.

The marshy areas of the county attract large numbers of migratory waterfowl. Urban areas are not extensive, but residential areas are expanding considerably, particularly near Dover.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in / / where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. / ,/ for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, / / is one of several phases within the / / series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of / /: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. / complex/ is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. / / association is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." / ./

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. / ./

While a soils survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind

of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

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General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in / /. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a /county (Area),/ who want to compare different parts of a /county (Area),/ or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey have been grouped into / / general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association / /, the words, / / refer to the texture of the surface layer.

The soil associations in / / county (Area)/ are discussed in the following pages.

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Outline for Text that Describes

and Interprets the Soil Association

I. Name of association. Be sure the narrative part of the description of all associations contains the same information. See that the name matches the corresponding one on the general soil map.

II. Give a word-picture of the surface appearance of the landscape. Names of features shown on the general soil map are helpful. The association can be located in the landscape but avoid locating it in some part of the county.

III. Give the approximate extent of the soil association (percent of the survey area). The percentages of all the soil associations should total 100. Give the approximate proportion of each important kind of soil in the association, in rounded percentages. Give the combined percentage of the minor soils. Percentages should total 100.

IV. Highlight the characteristics of the major kinds of soils. Cover only the most critical external and internal characteristics, and state these as they apply for the soil series.

A. Show how the major soils fit into the landscape.

B. Give only two or three important properties of each series; finish all discussion of properties for one series before beginning the next.

C. Mention names of minor soils and give (briefly) the position they occupy in the landscape.

D. Be sure that the soil properties given in the soil associations agree with those in the soil descriptions.

V. Give broad interpretations for each association, such as major soil uses, trends in use, and types of farming. Highlight the principal land uses, problems, and potentialities.

VI. Mention any special features of the soil association, such as mining, source of sand or gravel, etc.

VII. Use an appropriate block diagram if available. Block diagrams generally are more meaningful on soil associations that have highly contrasting relief. It is not necessary to have a block diagram for every association. Do not attempt to show more than one soil association in one diagram. Each diagram should show the dominant soils in an association in about the same proportion as that stated in the text. Soils described in text for this section as minor in extent should not be shown as major components on a diagram. All minor soils shown on a diagram must be named in the text, but not all minor soils named in the text need to be shown on a diagram.

GENERAL SOIL MAP

The general soil map in this publication shows, in color, the soil associations in Addison County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is also useful in determining the value of an association for a watershed, for woodland, for wildlife habitat, for engineering projects, for recreational areas, and for community development. A general soil map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The seventeen soil associations of Addison County are described in the following paragraphs.

SOILS THAT FORMED IN WATER-DEPOSITED MATERIAL IN THE CHAMPLAIN VALLEY

The soils that make up these associations are in the western half of the county in the Champlain Valley. They formed mainly in water-deposited material that ranges from sand to clay in texture. Also, there are areas of organic soils consisting of Muck and Peat. The soils are generally level to moderately sloping, and the associations comprise the main farming areas in the county.

1. Vergennes-Covington association

Gently sloping and moderately sloping, moderately well drained to poorly drained, clayey soils; on broad lake plains and terraces

This association is the largest in the county and occupies about 36 percent of the total acreage. Clayey soils are dominant in the association. The landscape is an undulating to rolling lake plain that is dissected by streams in many places. Rocky knolls and narrow ridges are prevalent, mainly in the eastern part. The association extends north and south the entire length of the county and from Lake Champlain to the foothills of the Green Mountains.

Vergennes soils are moderately well drained, clayey, and mainly gently sloping or moderately sloping. They comprise 60 percent of the association. Covington soils also are clayey, but they are somewhat poorly drained or poorly drained. They occupy the lowest positions of the landscape and make up 20 percent of the association. The remainder of the association is made up of the well-drained, loamy Nellis soils, the somewhat excessively drained Farmington soils, the somewhat poorly drained, clayey Panton soils, and the very poorly drained Livingston soils. Farmington and Nellis soils occupy the higher knolls and narrow ridges. These areas are commonly shallow to limestone bedrock or are stony and rocky. Panton and Livingston soils prevail in similar positions as the Covington soils.

This association is more suitable for farming than any others in the county. Dairying is the major farm enterprise. Most of the association has been cleared of trees and is farmed. The main crops are corn, hay, and pasture. Orchards are present on the higher and better drained sites. Artificial drainage is commonly needed for removing excess water from the Covington, Panton, and Livingston soils. Stoniness is seldom a limitation on the clayey soils in this association, but stones and bedrock outcrops limit farming on the higher ridges of the Nellis and Farmington soils. Many of the higher ridges are still wooded because of the rockiness or stoniness. Flooding is a hazard on the narrow bottom lands, especially those in the eastern part of the association.

In many places the steep banks along Lake Champlain are severely eroded by wave action. Structures placed immediately adjacent to the lake are subject to damage by erosion and by slumping of soil material.

2. Covington association

Nearly level, dominantly somewhat poorly drained and poorly drained, clayey soils; on lake plains

This association occupies about 4 percent of the county. It is in the lowest part of the landscape in the towns of Ferrisburg, Panton, and Addison in the western part of the Champlain Valley. The association is dominantly nearly level but includes small gently sloping or moderately sloping escarpments and knolls. The Dead Creek Waterfowl Area, which is permanently under water, also lies within this association.

The Covington soils make up about 80 percent of this association. These soils are somewhat poorly drained and poorly drained and, therefore, are excessively wet during the spring and other wet periods. The Panton soils are also present and occupy similar positions as the Covington soils, but they differ from the Covington soils mainly in their lighter colored surface layer. The remainder of the association is comprised of slightly higher knolls and escarpments of the moderately well drained, clayey Vergennes soils.

Most areas of this association have been cleared of trees and are now used for farming. Dairy farming is the major farm enterprise; and corn, hay, and pasture are the major crops grown in this association. Birdsfoot trefoil is grown for seed in some areas. Excess wetness is the major limitation in using the soils for farming. The slowly permeable clay restricts internal drainage and causes surface water to drain slowly. Water ponds on the surface for short periods of time in the spring and following hard rains. Farm machinery also is easily bogged down when the soils are wet, and during some years it is difficult to harvest crops. Farmers have installed artificial drainage in many areas to overcome the limitation of excess wetness.

3. Swanton-Elmwood association

Nearly level and gently sloping, moderately well drained to poorly drained, loamy soils; in depressions and on broad flats

This association occupies about 1 percent of the county. It lies mainly in the northwestern part of the county in the towns of Ferrisburg and Panton. A small area is in the town of New Haven. This association consists mainly of a nearly level, low-lying area within the Champlain Valley. It is similar to association 2 but differs in that a high percentage of the acreage is occupied by soils that are made up of sandy or loamy material over clayey material.

The somewhat poorly drained and poorly drained Swanton soils occupy about 60 percent of the association. These soils are comprised of loamy material that overlies clayey material at a depth of about 20 to 30 inches. Swanton soils lie in the lowest part of the association and, therefore, have a high water table during the spring and other prolonged wet periods. The Elmwood soils, coarse variant, comprise about 30 percent of the association. Unlike the Swanton soils, they consist of sandy material over the

clayey material, and they have better natural drainage. They occupy the slightly higher positions and have better surface drainage than the Swanton soils. Minor soils make up the rest of the association. They are the somewhat excessively drained, gravelly Stetson soils and the moderately well drained to poorly drained, sandy Duane and loamy over sandy Walpole soils. Small areas of bottom lands also are present, as well as areas of Muck and Peat 5 to 10 acres in size.

Most of the acreage in this association is farmed, except for areas that are difficult to drain artificially. Dairying is the major farm enterprise; and hay, pasture, and corn are the major crops grown in this association. Birdsfoot trefoil also is grown for seed in areas that are adequately drained. Excess water, on the surface and in the soil, is the main limitation for farming. Excess wetness delays tillage in spring and hinders harvesting of crops if fall is wet. Small woodlots still remain where it is difficult to use artificial drainage. Gray birch is prevalent in these undrained areas.

4. Raynham-Amenia association

Level to moderately sloping, poorly drained to moderately well drained, loamy soils; on broad flats and in depressions

This association comprises about 1 percent of the county. Poorly drained soils are dominant in the association, but moderately well drained and well drained soils also occur. Small creeks and drainageways dissect the association in many places, and rocky knolls and narrow ridges are in some places. Two areas of this association are present in the northeastern part of the Champlain Valley in the town of Monkton. This association occupies broad lowlands in the foothills of the Green Mountains. Several areas of Muck and Peat lie in these same lowlands.

The Raynham soils are somewhat poorly drained or poorly drained, mainly level, and loamy. They comprise about 70 percent of the association. Because they occupy the lowest positions, these soils commonly have a high water table and are excessively wet, unless they are artificially drained. The moderately well drained, loamy Amenia soils make up about 15 percent of the association. These gently sloping or moderately sloping soils occupy slightly higher positions and have better surface and internal drainage than the Raynham soils. Minor soils are the somewhat poorly drained or poorly drained Swanton soils, the well-drained Melrose soils, and the well-drained Salmon soils. These minor soils make up the remaining 15 percent of the association.

Most areas of this association have been cleared of trees and are now used for farming. Dairying is the major farm enterprise. The main crops are corn, hay, and pasture. Artificial drainage is commonly needed for removing excess water from the Raynham soils. The major limitation for growing farm crops is the excess wetness of the dominant soils, as a result of a high water table.

5. Winooski-Limerick association

Nearly level or depressional, moderately well drained to poorly drained, loamy soils; on bottom lands subject to flooding

This association lies along the major rivers and creeks in the county. It occupies about 1 percent of the county. Loamy soils that are subject to flooding are dominant in the association. These soils occupy the bottom lands that are mainly adjacent to Otter Creek, Middlebury River, and New Haven River. Other areas of this association are adjacent to other creeks and rivers throughout the county, but these areas are too small to show on the general soil map.

The Winooski soils are moderately well drained, loamy, and level. They comprise about 50 percent of the association. These soils occupy the slightly higher bottom lands or low terraces. The Limerick soils also are loamy and level, but they are poorly drained. They occupy the lower bottom lands in about 40 percent of the association. Although both the Winooski and Limerick soils are subject to flooding, the Limerick soils tend to be flooded more frequently. The well-drained Hadley soils are minor soils on the higher terraces and bottom lands. They make up the remaining 10 percent of the association. Some areas of the Hadley soils are above normal overflow and are seldom flooded.

Most areas of this association have been cleared of trees and are farmed intensively. The main crops are corn, hay, and pasture. Flooding is a limitation for growing crops during the spring and other wet periods. In addition, the Limerick soils have a high water table and are excessively wet unless artificial drainage is provided. Flooding also is a potential hazard in using the soils for recreation and community development.

6. Muck and Peat association

Level, very poorly drained, organic soils; in depressions and stream valleys

This association comprises about 3 percent of the county. The largest area is in the southern part of the county along Otter Creek in the towns of Whiting and Leicester. Smaller areas are in the northern part of the county, in the towns of Monkton and Bristol, and in the southern part of the county in the towns of Bridport, Shoreham, and Orwell. This association lies in the lowest areas of the landscape and, therefore, the soils have a high water table.

Muck and Peat make up about 95 percent of the association. Muck and Peat formed from the remains of plants and animals associated with a high water table. Water is at the surface or covers it during the wettest periods of the year. Where Muck and Peat are adjacent to creeks or rivers, they are also subject to periodic flooding. Small areas of poorly drained mineral soils also are present and make up the remaining 5 percent of the association. These soils also have a high water table and occur on small,

slightly higher knolls within the landscape. The three areas of this soil association adjacent to Lake Champlain are comprised of Fresh water marsh and soils of the bottom lands. The areas of Fresh water marsh are covered by shallow water most of the year. The soils of the bottom lands are subject to flooding during spring and other wet periods.

Most of this association is seldom farmed. It is now idle or is used to a limited extent for pasture. The excess wetness, the lack of adequate drainage outlets, and the poor potential for farming when once drained are severe limitations to the use of this association for farming and for community development. The organic material has poor stability and poor capacity to support loads. Therefore, it has severe limitations that affect its use for buildings or other intensive development. The association is well suited to development as habitat for wetland wildlife.

7. Colton-Stetson-Adams association

Level to moderately steep, excessively drained and somewhat excessively drained, sandy soils; on old lake beaches and terraces

This association makes up about 2 percent of the county. It consists of old lake beaches and terraces that are comprised mainly of gravelly sand and sandy soils. Most areas of the association border the eastern part of the Champlain Valley or are along the major streams within the foothills of the Green Mountains. The largest area of this association lies within and adjacent to the village of Bristol.

The Colton soils are dominant in the association and make up about 60 percent of it. These soils are excessively drained and formed in gravelly sand. They are droughty during prolonged dry periods. The Stetson soils make up about 20 percent of the association. They differ from the Colton soils mainly in that they have a finer textured subsoil. The Adams soils comprise 10 percent of the association and consist of sandy material. Minor soils, which make up the remaining 10 percent of the association, are the moderately well drained Duane soils and the somewhat poorly drained or poorly drained Walpole soils.

Farming and woodland are the main uses of the soils in this association. The steepest soils in the association are presently used as woodland and are most suitable for this use. The less sloping soils are used for growing corn, hay, and pasture. Because the soils are gravelly and sandy, they tend to be droughty and have a low capacity to supply plant nutrients. This association also is a good potential source for sand and gravel; sand and gravel pits prevail throughout the association. The dominant soils also provide good foundations for buildings.

SOILS THAT FORMED IN GLACIAL TILL IN THE CHAMPLAIN VALLEY

The soils that make up these associations lie in the western half of the county in the Champlain Valley. They formed in glacial till and are commonly stony. The soils occupy the ridges and hills that rise above the broad lake plain.

8. Farmington-Nellis association

Gently sloping to moderately sloping, excessively drained to well-drained, loamy soils that lie on ridges and are dominantly shallow over limestone bedrock

This association makes up about 3 percent of the county. It comprises the higher ridges and knolls in the Champlain Valley. The ridges and knolls are generally 1/2 mile to 2 miles wide and extend 1 to 4 miles north and south. Outcrops of limestone bedrock are common.

The dominant soils, which comprise 80 percent of the association, are the somewhat excessively drained, shallow, loamy Farmington soils. These soils formed in loamy material that overlies limestone bedrock at a depth of 10 to 20 inches. They are commonly stony and rocky and are gently sloping to very steep. Nellis soils, which make up about 15 percent of the association, are well drained and deep and are mainly gently sloping or moderately sloping. In contrast to the Farmington soils, they are underlain by bedrock at a depth of more than 40 inches. Minor soils, which make up the remaining 5 percent of the association, are the moderately well drained Vergennes soils, the somewhat poorly drained or poorly drained Covington soils, and small areas of Rock land. The Vergennes and Covington soils are finer textured than the dominant Farmington and Nellis soils.

The soils of the major part of this association, mainly the moderately sloping Farmington soils, are too stony or rocky to be used intensively for farming. Some areas of the Nellis soils have been cleared of stones and are now used for farming. The major crops are hay, pasture, and to a lesser extent, corn. The influence from limestone bedrock makes the soils in this association especially suitable for growing alfalfa.

9. Nassau-Dutchess association

Sloping to steep, excessively drained to well-drained soils that lie on ridges and are dominantly shallow over slate bedrock

This association makes up about 1 percent of the county. It is in the extreme southwestern part of the county in the town of Orwell. The landscape is rolling or hilly uplands; the relief is determined by the underlying slate bedrock. The soils in this association are similar to those in association 10, but on a larger acreage they are shallow and steep.

The Nassau soils make up 90 percent of the association and consist of somewhat excessively drained or excessively drained, loamy soils that are shallow to bedrock. The Dutchess soils, which make up 10 percent of the association, are deep, well-drained, loamy soils. They formed in material similar to that in which the Nassau soils formed, but they do not have slate bedrock at a depth of less than 20 inches. The Nassau soils and Dutchess soils are gently sloping to steep. Both soils are stony, but the Nassau soils also have many rock outcrops.

The present use of the soils in this association is mainly as woodland. However, areas of the Dutchess soils that have been cleared of stones are used for farming. Major crops in these farmed areas are corn, hay, and pasture. The outcrops of bedrock, the shallow depth in many places, and the abundance of stones on the surface are severe limitations to use for farming throughout the association. Erosion by water also is a potential hazard where a protective cover of vegetation is not maintained.

10. Dutchess-Nassau association

Moderately sloping to steep, well-drained to excessively drained, loamy soils that are dominantly deep over slate bedrock

This association makes up about 1 percent of the county. It consists of two areas in the southwestern part of the county in the towns of Orwell and Whiting. This association consists of a rolling upland within the Champlain Valley. Bedrock outcrops are common in part of the association, and stoniness is prevalent on most of the soils.

The Dutchess soils make up 80 percent of the association. They are deep, well drained, and loamy. Stones are common on the surface in many areas. The Nassau soils, which are somewhat excessively drained or excessively drained and shallow to slate bedrock, make up 15 percent of the association. Rock outcrops are present in areas of the Nassau soils. The Dutchess and Nassau soils are gently sloping to steep. The remainder of the association is comprised mainly of the well-drained, loamy Nellis soils.

This association is made up of soils that are similar to those in association 9, but it has a larger proportion of deep soils than association 9. The slopes also are more gentle, and, therefore, the soils in this association have greater potential for farming than those in association 9. Many areas have been cleared of trees and are now farmed. The major crops are corn, hay, and pasture. Stoniness limits use for farming in most areas of the association. Erosion also, is a potential hazard where the soils are moderately sloping or steep.

11. Nellis-Amenia association

Level to moderately sloping, well drained to moderately well drained, loamy soils that are dominantly deep

This association comprises about 3 percent of the county. It consists of high elongated ridges and knolls, mainly in the eastern and southern parts of the Champlain Valley. These ridges and knolls are 1/2 mile to 1-1/2 miles wide and 1 to 4 miles long in a north-south direction.

The Nellis soils make up 45 percent of the association. These soils are well drained, deep, and loamy. They are mainly gently sloping or moderately sloping. The Amenia soils make up 35 percent of the association. They also are deep and loamy, but unlike the Nellis soils, they

are moderately well drained. The Amenia soils are level or gently sloping and occupy lower positions on the landscape than the Nellis soils. The minor soils, which account for the remaining 20 percent of the association, are the shallow Farmington soils and the somewhat poorly drained and poorly drained Massena soils. Farmington soils occupy the steeper slopes in the association, where rock outcrops are present. Massena soils occupy the lowest lying areas; excess water is a limitation on these soils.

At one time, most of the soils in this association were too stony for farming, but farmers have removed the stones in many areas and the present use is farming. Areas still remain that are too stony or rocky for growing farm crops. These areas are presently wooded or are idle. A few orchards also are in this association.

SOILS OF THE GREEN MOUNTAINS AND ASSOCIATED FOOTHILLS

The soils that make up these associations lie in the eastern half of the county on the main range and foothills of the Green Mountains. They are dominantly well drained, loamy, and moderately sloping to steep. Moderately well drained to poorly drained soils occupy the lower slopes and foothills. Most of the acreage in these associations is wooded because the soils are too stony, too rocky, or too steep for farming.

12. Lyman-Berkshire-Marlow association

Steep to very steep, excessively drained to well-drained, loamy soils that are shallow to deep over bedrock; on main ranges

This association is the steepest and most mountainous association in the county. It occupies 19 percent of the county. Most of the association occupies the main ranges of the Green Mountains, but a few areas are in the foothills of the Green Mountains and in the Champlain Valley. Forests cover most of this association; a large acreage is in the Green Mountain National Forest.

The Lyman soils make up 55 percent of the association. These soils are somewhat excessively drained or excessively drained and are shallow to bedrock. They are extremely rocky and stony in most areas. The Berkshire soils make up 25 percent of the association, and the Marlow soils comprise 20 percent. The Marlow and Berkshire soils are both well drained and deep. The Marlow soils differ from the Berkshire soils mainly in that they have a slowly permeable hardpan within 30 inches of the surface. The Marlow and Berkshire soils also are stony or extremely stony and steep or very steep. Rock land also is present in the association, especially on the bluffs adjacent to the Champlain Valley. Very little soil material occurs in areas of Rock land. Minor soils are the Berkshire soils that are moderately sloping and the moderately well drained, loamy, Peru soils.

Most areas in this association are too rocky, stony, and steep for farming. Trees are growing on most areas of the association, but the steep slopes and rocky soils also hinder use as woodland. The Long Trail passes through this association; therefore, hiking is a recreational use.

13. Berkshire-Marlow, sloping, association

Moderately sloping, well-drained, stony, loamy soils; on foothills

This association comprises about 12 percent of the county. It occupies the moderately sloping foothills of the Green Mountains. This association has soils similar to those in soil association 14. It differs in that the soils are moderately sloping rather than steep.

The Berkshire and Marlow soils are dominant in the association. Berkshire soils comprise about 45 percent of the association, and the Marlow soils comprise about 40 percent. The Berkshire soils are deep, well drained, and loamy. Most areas that are not now farmed are stony or extremely stony. The Marlow soils also are well drained and loamy, but a hardpan is present at a depth of less than 30 inches. Minor soils are steep Peru, Cabot, and Berkshire soils; and there are some small areas of Rock land. The Peru and Cabot soils are moderately well drained to poorly drained and occupy the lower slopes. Minor soils occupy 15 percent of this association.

Most areas of this association are presently in trees. The less sloping and less stony areas are used for dairy farming. A large part of this association is in the Green Mountain National Forest. Stoniness and moderate slopes are the main limitations to use for farming. Areas that are farmed intensively are subject to erosion unless conservation measures are used. Recreational uses are increasing in the association, and the potential for such uses is good.

14. Berkshire-Marlow, steep, association

Steep, well-drained, stony, loamy soils; on foothills

This association makes up about 6 percent of the county. It lies adjacent to soil association 12 but has a smaller proportion of Rock land and of shallow soils. This association is characterized by steep and very steep soils that are stony and rocky.

The Berkshire soils comprise about 50 percent of the association, and the Marlow soils comprise about 40 percent. Both of these soils are well drained and loamy, but the Marlow soils have a hardpan at a depth of 15 to 30 inches. These soils are stony, and in some places rock outcrops are present. Minor soils make up the remaining 10 percent of the association; they are the somewhat excessively drained or excessively drained, shallow Lyman soils and areas of Rock land.

The steep slopes and generally stony and rocky soils are severe limitations to the use of this association for farming. Most areas are presently woodland and are generally suited for this use. Recreational use is increasing, and the area has potential for this use.

15. Calais-Cabot-Buckland association

Moderately sloping to steep, well-drained to poorly drained, stony, loamy soils; on lower slopes of main ranges

This association lies entirely in the town of Granville and comprises about 1 percent of the county. It occupies the lower slopes of the main range of the Green Mountains.

Calais soils make up about 70 percent of the association. These soils are deep, well drained, loamy, and mainly moderately sloping to steep. The Cabot soils occupy 15 percent of the association and are somewhat poorly drained or poorly drained and loamy. The Cabot soils occupy the lower side slopes that receive seepage water from the hills. The Buckland soils, which are mainly sloping or moderately sloping, make up about 10 percent of the association. These soils are moderately well drained, deep, and loamy. Other soils are the Glover and Berkshire soils, which occupy the remaining 5 percent of the association. Glover soils are shallow to bedrock and are somewhat excessively drained to excessively drained. Rock outcrops are present in the areas of Glover soils. The Berkshire soils are well drained and occupy the moderately sloping and steep areas of the association. Small bottom lands and drainageways are present. These bottom lands are subject to seasonal flooding.

Most of this association is presently in forest. Some of the less sloping soils have been cleared of trees and stones and are farmed to a limited extent. The bottom lands are farmed in local areas where flooding is less severe.

16. Berkshire-Cabot-Peru association

Moderately sloping, well-drained to poorly drained, stony, loamy soils; on lower slopes and foothills

This association makes up about 4 percent of the county. It occupies lower side slopes and foothills of the Green Mountains.

The dominant soils are the well drained, loamy, moderately sloping Berkshire soils. These soils comprise about 50 percent of the association. The Berkshire soils are stony and subject to erosion if not protected by vegetation. The Cabot soils make up 25 percent of the association. These soils are somewhat poorly drained or poorly drained and occupy the lower slopes that receive seepage. The Peru soils also occupy the lower slopes, but they are moderately well drained. Peru soils make up 20 percent of the association. The remaining 5 percent of the association is made up of the excessively drained Stetson and Colton soils, the shallow Lyman soils, and very poorly drained Muck and Peat.

Much of this association was once used as farmland, but it has been allowed to revert back to woodland. The presence of many stone fences is evidence that these soils were once farmed. The Cabot and Peru soils have a limitation of excess wetness and, therefore, require artificial drainage if used extensively for farming.

17. Peru-Cabot association

Gently sloping to moderately sloping, moderately well drained to poorly drained, stony, loamy soils; on lower slopes and foothills

This association makes up about 2 percent of the county. It occupies the lowest positions on side slopes of the foothills of the Green Mountains. This association has the highest proportion of excessively wet soils in the Green Mountains and their foothills.

Peru soils make up 50 percent of the association. They are moderately well drained, loamy, and gently sloping or moderately sloping. The Cabot soils occupy about 40 percent of the association. They are somewhat poorly drained or poorly drained and loamy. Stoniness is a limitation on both of the major soils, and many areas are now extremely stony. Minor soils are the well-drained Berkshire soils and the shallow, somewhat excessively drained Lyman soils.

This association has been cleared of trees and stones in many areas and was once used for farming. Some areas are still used for farms, but many have been abandoned and have grown up to trees and brush. Excess wetness limits the growing of farm crops unless artificial drainage is provided.

Descriptions of the Soils

This section describes the soil series and mapping units in / / /County or Area/. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for / dry (or moist) / soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. The description of each mapping unit contains suggestions on how the soil can be managed.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. / /, for example, do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parenthesis. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, and woodland group in which the mapping unit has been placed. The page for the description of each / / or other interpretative group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*3*). 1/

1/ Italic numbers in parentheses refer to Literature Cited, p.

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Outline for Describing Soil Series in Published Soil Surveys

I. Name of series.

II. In the introductory paragraph, give a few of the major features that characterize soils of the series and are important to their behavior under use. Describe the setting for soils of the series. This should include the position on the land surface, the shape and the gradient range of slope, and the nature of parent materials where known with reasonable confidence. A brief statement about native vegetation should be included if the soils of the survey area formed under different major kinds of vegetation and it has influenced their properties.

III. Describe the profile in nontechnical terms (one paragraph). Abstract this profile from the detailed technical profile chosen as representative for the series in the survey area. Characteristics commonly covered are color, texture, and thickness of the surface layer; color, texture, consistence, and thickness of the subsoil; color and texture of the underlying material; and depth to and kind of bedrock if bedrock is at a depth of less than 60 inches. Mention special features if they are important.

IV. In a paragraph, give the significant observed and inferred properties of the soils. Give those basic interpretations that are the same for all the soils of the series in the survey area.

V. Give a brief statement of soil suitability or use.

VI. Describe the representative profile in technical terms. Give the legal location of the profile. Describe the profile fully, using standard terminology. Describe the soil to a depth of 60 inches or to bedrock if it is less than 60 inches.

VII. Give the ranges in properties of major horizons and of other major features characteristic of the series. In this paragraph, use horizon nomenclature from the technical profile. The ranges described should be restricted to the series in the survey area and must not include ranges that are outside the most recent draft of the standard series description. Properties and features outside the ranges of the official series description are mapping inclusions and should be described in the mapping unit descriptions if they are important enough to affect use and management.

VIII. Mention briefly how the series described compares or contrasts with two or three other series in the survey area that are closely associated geographically or are morphologically similar. In the first sentence tell why they are compared.

Outline for Describing

the Mapping Unit

I. Identify the mapping unit by the exact correlated name. If percent of slope is not a part of the name, add it in parentheses, or you may state it in the first sentence of the mapping unit description. Give map symbol.

II. Describe the setting and features that can be readily noted on the surface if details other than those given at the series level are important. Give shape of surface if significant and size and shape of most areas, as well as the range in these features, to reflect differences. Describe stones, rock outcrops, or gravel on surface if significant.

III. Briefly describe profile features of the soil that are significantly different from the profile that is representative for the soil series in the survey area. One mapping unit in each multiphase series, has the profile that is representative for the series in the survey area and the description should state that fact. The description of the mapping unit of a monophase series should contain no comparative description of a soil profile. Mention inclusions that are contrasting enough to affect the use of the soil as shown on the map. Mention features identified by ad hoc symbols.

IV. Highlight important basic items of interpretations. Items for which interpretations might be useful include soil drainage class, hazards of erosion or flooding, permeability, and plant nutrient deficiences. Give the main problems of management. The discussion of applicable practices and other management belongs in the capability unit.

V. Give a brief statement about present use of the soil, together with its comparative suitability for present uses and other uses not yet common in the community.

VI. List interpretative groups (not more than three) into which this mapping unit has been placed.

Belknap Series

The Belknap series consists of deep, somewhat poorly drained, nearly level soils on flood plains. These soils formed in alluvium that washed mostly from loess. They are in valleys and low areas throughout the survey area.

In a representative profile the surface layer is brown silt loam about 6 inches thick. The subsoil is 24 inches thick. The upper 12 inches is brown silt loam mottled with grayish brown and dark grayish brown. The lower 12 inches is grayish-brown silt loam mottled with dark yellowish brown. The underlying material, starting at a depth of 30 inches and reaching to a depth of 68 inches or more, is grayish-brown or dark-gray silt loam mottled with light yellowish brown, olive brown, or light olive brown.

These soils have a plow layer that is easy to till. Roots and moisture penetrate at a favorable rate. The root zone is deep, except when limited by a seasonal high water table. The available moisture capacity is high, the natural fertility is moderate, and the organic-matter content is low. Crops make good response to lime and fertilizer.

These soils are used mostly for row crops, hay, or pasture. A few areas are in woods or are idle.

Representative profile of Belknap silt loam located 2 miles north of Calhoun, one-half mile east of State Route 81 and 200 feet south of Long Falls Creek:

Ap--0 to 6 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many roots; strongly acid; clear, smooth boundary.

B21--6 to 18 inches, brown (10YR 5/3) silt loam; few, fine, faint mottles of grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2); weak, medium, subangular blocky structure; very friable; few worm casts; few roots; strongly acid; gradual, smooth boundary.

B22g--18 to 30 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct mottles of dark yellowish brown (10YR 4/4); weak, medium and fine, subangular blocky and granular structure; friable; few, small, brown concretions; strongly acid; gradual, smooth boundary.

C1g--30 to 42 inches, grayish-brown (10YR 5/2) silt loam; few, coarse, distinct mottles of light yellowish brown (10YR 6/4) and few, fine, faint mottles of olive brown (2.5Y 4/4); massive; very friable; strongly acid; clear, smooth boundary.

C2g--42 to 68 inches +, dark-gray (N 4/0) silt loam; few, fine, distinct mottles of light olive brown (2.5Y 5/4); massive; very friable; few strata of sand 1/2 to 1 millimeter thick in lower part; few, small, black concretions; strongly acid.

The depth to bedrock is more than 5 feet. The solum is 25 to 40 inches thick. The reaction is very strongly acid or strongly acid throughout the profile. The Ap horizon, however, is less acid where it has been limed. The texture is silt loam or silt throughout the profile.

The Ap horizon ranges from brown (10YR 5/3) to dark yellowish brown (10YR 4/4). The B21 horizon has dominant colors ranging from brown (10YR 5/3) to dark yellowish brown (10YR 4/4). Mottles in the B21 horizon are few to many and range from gray (10YR 5/1) to dark grayish brown (10YR 4/2). The structure of this horizon is weak granular or subangular blocky. The B22g horizon has dominant colors ranging from light brownish gray (10YR 6/2) to dark gray (10YR 4/1). Mottles in the B22g horizon are common to many and range from pale brown (10YR 6/3) to dark yellowish brown (10YR 4/4). The C horizons have dominant colors ranging from dark gray (N 4/0) to light gray (10YR 7/2) and light brownish gray (2.5Y 6/2). They are mottled with grayish and brownish colors.

The Belknap soils are near the moderately well drained Collins soils and poorly drained Waverly soils. They are similar to the Newark soils in drainage but are more acid and contain less clay.

Belknap silt loam (Be).--This nearly level soil formed in recent alluvium along streams and in narrow valleys near soils of the uplands that formed in loess. Slopes are mostly 0 to 2 percent by range up to about 4 percent.

Included with this soil in mapping are a few small areas of Collins and Waverly soils. Also included are small areas where the surface layer is loam or fine sandy loam, areas where the subsoil is silty clay loam, and areas medium acid or slightly acid below a depth of 20 inches. In the southern part of the survey area are included areas that are 5 to 10 percent gravel throughout the profile.

This soils is not subject to erosion and can be used for intensive cropping without loss of soil material. It is subject to flooding, which generally occurs in winter or spring. Also, this soil has a seasonal high water table that limits use unless drainage has been provided. This soil is suited to corn, soybeans, hay, and pasture. Capability unit IIw-1; woodland suitability group 1w1.

Memphis Series

The Memphis series consists of deep, well-drained soils on uplands. These gently sloping to moderately steep soils are on the tops and sides of ridges in areas highly dissected by a dendritic drainage system. They formed in loess more than 4 feet thick.

In a representative profile the surface layer is brown silt loam about 8 inches thick. The subsoil is silty clay loam that extends to a depth of about 40 inches. It is brown in the upper part and strong brown in the middle and lower parts. The underlying material is dark yellowish-brown silt loam that extends to a depth of 60 inches or more.

These soils have a deep root zone, moderate permeability, and high available moisture capacity. Crops respond well to lime and fertilizer.

Most areas of these soils are used for row crops, hay, and pasture. A few of the steeper areas are in woods or are idle.

Representative profile of Memphis silt loam, 2 to 6 percent slopes, located 3 miles west of Owensboro, one-half mile north of U.S. Highway 60, and 100 feet east of a cemetery:

Ap--0 to 8 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; many roots; slightly acid; clear, smooth boundary.

B21t--8 to 14 inches, brown (7.5YR 4/4) light silty clay loam, moderate, fine and very fine, subangular blocky structure; friable; few roots; few patchy clay films on peds; strongly acid; gradual, smooth boundary.

B22t--14 to 34 inches, strong-brown (7.5YR 5/4) light silty clay loam; moderate, fine, subangular blocky structure; friable; few roots; continuous brown (7.5YR 4/4) clay film on peds; strongly acid; gradual, smooth boundary.

B3t--34 to 40 inches, strong-brown (7.5 YR 5/6) light silty clay loam; weak, medium, subangular blocky structure; friable; black concretionary stains on some ped surfaces; patchy clay films on peds; strongly acid; gradual, smooth boundary.

C--40 to 60 inches +, dark yellowish-brown (10YR 4/4) silt loam; few, fine, faint mottles of pale brown (10YR 6/3); massive; friable; medium acid.

Depth to bedrock is more than 6 feet. The solum is 32 to 50 inches thick and very strongly acid to medium acid. The A horizon, however, is less acid where it has been limed.

The Ap horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4). The Bt horizons range from brown (7.5YR 4/4) to strong brown (7.5YR 5/6) in color, from heavy silt loam to silty clay loam in texture, and from weak to moderate in structure. The C horizon ranges from brown (7.5YR 4/4) to yellowish brown (10YR 5/6) and in some places has a few gray or pale-brown mottles. The C horizon ranges from strongly acid to slightly acid.

The Memphis soils are near Loring, Grenada, and Wellston soils. They are better drained than the Loring and Grenada soils, which have a fragipan. They formed in a thicker loess mantle and are deeper to bedrock than Wellston soils.

Memphis silt loam, 2 to 6 percent slopes (MmB).--This soil is mostly on ridgetops and has slightly convex slopes. It is in winding areas 200 to 500 feet wide that cover 5 to 20 acres. The profile of this soil is described as representative of the series.

Included with this soil in mapping are a few areas of Loring soils and a few areas of Memphis soils having slopes of 6 to 10 percent. Also included is a soil that is 4 to 6 feet deep to bedrock.

This Memphis soil is moderate in natural fertility and low in content of organic matter. It can be tilled throughout a wide range of moisture content without crusting or clodding.

This soil is suited to all the crops commonly grown in the area. The erosion hazard is moderate, and some measures for controlling erosion are needed if cultivated crops are grown. This soil is used mostly for corn, tobacco, hay, and pasture. The farm buildings on many farms are on this soil. Capability unit IIe-1; woodland suitability group 2o1.

Memphis silt loam, 6 to 12 percent slopes (MmC).--This soil has slopes that are commonly 400 to 800 feet long. It is in areas of about 5 to 40 acres, and many of the larger areas are dissected by drainageways.

Included with this soil in mapping are small areas of Loring and Wellston soils. Where this soil is dissected by drainageways, long narrow areas of Collins and Belknap soils are also included. Small areas of severely eroded soils are included and are identified on the soil map by the symbol for a severely eroded spot. Near the bottom of some slopes, small areas of poorly drained soils are included and are identified on the soil map by the symbol for a wet spot.

This soil is low in content of organic matter and moderate in natural fertility. It is easy to till.

This soil is suited to all of the crops commonly grown in the area. The erosion hazard is severe, and control of erosion is needed where cultivated crops are grown. This soil is used mostly for corn, hay, and pasture. A few areas are wooded. Capability unit IIIe-1; woodland suitability group 2o1.

Memphis silt loam, 12 to 30 percent slopes (MmE).--This soil has slopes that are commonly 300 to 800 feet long. It is in areas of 5 to 50 acres, many of which are dissected by drainageways. The profile of this soil differs from the one described as representative of the series in that the surface layer is about 6 inches thick.

Included with this soil in mapping are a few areas of Loring and Wellston soils. Where this soil is dissected by drainageways, small areas of Collins and Belknap soils also are included.

This soil is low in content of organic matter and moderate in natural fertility. Except for steepness of slope, it is easy to till.

This soil is generally not suitable for cultivation, because of erosion hazard and slope. It is used mostly for hay, pasture, or woods. Capability unit VIe-1; woodland suitability group 2o1.

Memphis silty clay loam, 6 to 12 percent slopes, severely eroded (MnC3).--This soil has slopes that are mostly 400 to 800 feet long. It is in areas 5 to 50 acres in size, and many of the larger areas are dissected by drainageways. The profile of this soil has a redder surface layer and higher content of clay than the one described as representative of the series. In places, erosion either has removed the surface layer from more than 50 percent of an area, or 20 to 30 percent of the acreage is made up of rills and gullies 2 to 3 feet deep.

Included with this soil in mapping, between gullies and near the bottom of slopes, are uneroded areas of Memphis silt loam. Near the bottom of some slopes, small areas of poorly drained soils are included and are identified on the soil map by the symbol for a wet spot. Where this Memphis silty clay loam is crossed by drainageways, areas of Collins and Belknap soils are included. Also included are small areas of Loring and Wellston soils.

This soil is moderately low in natural fertility and very low in content of organic matter. The silty clay loam texture of the surface layer makes this soil slightly difficult to till.

The hazard of erosion is very severe, and control of erosion is needed if this soil is cultivated. This soil is used for row crops, hay, and pasture. A few areas are idle or in woods. Capability unit IVe-2; woodland suitability group 3o1.

Memphis silty clay loam, 12 to 30 percent slopes, severely eroded (MnE3).--This soil has slopes that commonly are 300 to 800 feet long. It is in areas 5 to 20 acres in size that generally are dissected by drainageways. The profile of this soil has a redder surface layer and higher content of clay than the one described as representative of the series. Individual areas of this soil either have lost the surface layer from more than 50 percent of their extent, or 20 to 35 percent is cut by gullies 2 to 4 feet deep.

Included with this soil in mapping, between gullies and at the bottom of slopes, are uneroded areas of Memphis silt loam. Also included are small areas of Loring and Wellston soils.

This soil is moderately low in natural fertility and very low in content of organic matter. The silty clay loam texture and slope make this soil difficult to till.

This soil is not suitable for cultivation but is suitable for permanent vegetation. It is used mostly for pasture or woods, or is idle. Trees and other native plants are revegetating areas that are idle. Capability unit VIe-5; woodland suitability group 3o1.

Frankstown Series

The Frankstown series consists of deep, well-drained, mostly undulating to rolling soils on uplands. These soils formed in material weathered from silty limestone and interbedded limy shale. They are in an area characterized by low, rounded, parallel ridges that are separated by drainageways of intermittent streams. The sides of many of the ridges are marked by outcrops of partly weathered limestone.

In a representative profile the surface layer is dark grayish-brown shaly silt loam about 5 inches thick. The subsurface layer is yellowish-brown shaly silt loam about 7 inches thick. The subsoil extends to a depth of 29 inches. In the upper 5 inches it is yellowish-brown shaly silt loam, and in the lower 12 inches it is strong-brown shaly silty clay loam. Below the subsoil, to a depth of 60 inches, is strong-brown and dark-brown shaly silt loam. Siliceous limestone is below the shaly silt loam.

Frankstown soils are fertile and easily worked. Permeability is moderate. Available water capacity is high.

These soils are suited to crops and pasture and are extensively used for these purposes. They are well suited to orchards and generally are in positions where air drainage is good. Woodland is limited to small, scattered farm woodlots where these soils generally are very rocky.

Representative profile of Frankstown shaly silt loam, 12 to 25 percent slopes, in a pasture east of Molers Crossroads, 0.7 mile north of Shenandoah Junction:

Ap--0 to 5 inches, dark grayish-brown (10YR 4/2) shaly silt loam; weak, fine, granular structure; friable; many roots; 25 percent shale fragments up to 1 inch long; slightly acid; abrupt, smooth boundary.

A2--5 to 12 inches, yellowish-brown (10YR 5/4) shaly light silt loam; weak, medium, subangular blocky structure; friable; common fine roots; 30 percent shale fragments up to 2 inches long; many fine pores; slightly acid; clear, wavy boundary.

B21t--12 to 17 inches, yellowish-brown (10YR 5/6) shaly silt loam; moderate, medium subangular blocky structure; firm; few roots; 30 percent shale fragments up to 2 inches long; many fine pores; thin patchy clay films; medium acid; clear, wavy boundary.

B22t--17 to 26 inches, strong-brown (7.5YR 5/6) shaly silty clay loam; some yellowish-red (5YR 4/6) spots and streaks; moderate; medium, subangular blocky structure; firm; few roots; 30 percent shale fragments up to 2 inches long; common fine pores; medium, continuous clay films; common black manganese faces; medium acid; gradual, wavy boundary.

B23t--26 to 29 inches, strong-brown (7.5YR 5/6) shaly silty clay loam; weak, medium, subangular blocky structure; firm; few fine roots; 35 percent shale fragments up to 2 inches long; common fine pores; thin patchy clay films; very strongly acid; gradual, wavy boundary.

B&C--29 to 60 inches, strong-brown (7.5YR 5/6) and dark-brown (7.5YR 4/4) shaly silt loam; common streaks and pockets of yellowish-red (5YR 4/6) silty clay; massive; firm; 40 percent shale fragments up to 3 inches long, and quantity increases with depth; thin patchy clay films; strongly acid.

R--60 inches, shaly, buff-colored, siliceous limestone.

The A horizon is dominantly shaly silt loam or very rocky silt loam, but in some wooded areas there are fewer shale fragments in this layer. The B horizon ranges from shaly silt loam to shaly silty clay loam, and from yellowish brown to strong brown. Coarse fragments make up 10 to 40 percent of the B horizon. The B2t horizon ranges from 8 to 18 inches in thickness. Depth to bedrock is 4 to 7 feet, and in most areas the rock is rippable. Where they have not been limed, reaction of these soils ranges from very strongly acid to medium acid throughout.

Frankstown shaly silt loam, 2 to 6 percent slopes (FbB).--This soil is in long, narrow areas on the tops of ridges. Its profile is similar to that described as representative for the series but has fewer coarse fragments throughout.

Included with this soil in mapping were a few, small, strongly sloping areas, a few severely eroded areas, and a few limestone outcrops.

Almost all of this soil has been cleared, and a considerable acreage is now in orchards. This soil is well suited to all locally grown crops. It is well suited to orchards, but frost is a hazard in some locations. An occasional rock outcrop influences direction of tillage in some areas. Choosing a suitable cropping system, contour stripcropping, sodding of waterways, and practicing minimum tillage are ways to prevent excessive loss of water and soil material.

Slope is only a moderate limitation if this soil is used for septic tank filter fields, but contamination of the ground water through underlying solution channels is a problem in many areas. Capability unit IIe-1.

Frankstown very rocky silt loam, 6 to 12 percent slopes (FcC).--This soil is in narrow bands on the sides of ridges, between areas of gently sloping soils and narrow drainageways. This soil has a profile similar to the one described as representative for the series, but limestone outcrops cover as much as 25 percent of the surface, and depth to bedrock is more irregular.

Included with this soil in mapping are some gently sloping, very rocky Frankstown soils and some rocky and extremely rocky areas. Also included are some severely eroded areas and some that are shallower to bedrock.

Areas of this soil are wooded, but most of it is in pasture. Machinery can be used on all but the most rocky areas. In some areas limestone ledges affect movement of machinery and direction of tillage. Permanent pasture or tall-grass pasture adequately protects this soil from erosion. Capability unit VIs-1.

Describing Complexes

Describe each member of the complex in relation to its series description. Be sure there is a series description for each member.

Pocomoke-Berryland loamy sands (Pr).--This mapping unit is about 60 percent Pocomoke soils and 40 percent Berryland and other soils. The soils are nearly level, having slopes of 0 to 2 percent. The surface soil in most places is loamy sand, but in some places it is sandy loam or loam. The Pocomoke soil has a profile similar, except for texture of the surface layer, to the representative one described for its series. The Berryland soil has a profile similar to the representative one described for that series. Included in the areas mapped are small areas of a soil that has some characteristics of each of these soils, including a fine-textured subsoil similar to that of the Pocomoke soils and an organic layer similar to the one in Berryland soils. The soils in this mapping unit form such an intricate pattern that it is not practical to map them separately at the scale of the soil map.

Most areas of this mapping unit are in forest. These soils are suited to highbush blueberries if the water level is managed.

The high water table and a flooding hazard are severe limitations for use of these soils for farming, residential, commercial, or industrial purposes. The soils generally furnish good sites for ponds for irrigation, wildlife, or recreation. (Capability unit IIIw-25; woodland suitability group 4)

Describing Undifferentiated Groups

Describe each member of the undifferentiated group in relation to its series description. Be sure there is a series description for each member.

Ilion and Lyons silt loams, 0 to 3 percent slopes (IlA).--In most places these soils occupy small wet depressions. Most of the areas consist of the Ilion soil, others consist of the Lyons soil, and a few are made up of both soils. Each of these soils has a profile similar to the one described as typical for its respective series.

Soils in this group receive runoff from adjacent higher lying soils. The areas generally have a thin deposit of silt and clay on them that was washed from the higher areas. Most areas are in pasture or trees. The wooded areas have a thin, mucky surface layer in most places. In pastured areas mineral material from the upper part of the soil has been mixed with the mucky material.

Included with these soils on knolls are small areas of better drained soils from similar materials. Also included are small areas of muck.

Undrained areas of these Ilion and Lyons soils can be used for pasture, for woodland, or for wildlife areas. Plants that tolerate wetness are the only ones that are suitable for undrained areas. Corn, small grains, and hay are suitable for drained areas. Small grains, however, are susceptible to lodging, because nitrogen is released rapidly in midsummer. Developing the areas as marsh for wildlife is a good use. The soils also provide good sites for farm ponds. Wetness limits use for most buildings and for many recreational purposes. (Capability unit IVw-1; woodland suitability group 8)

Describe the slope and components of the mapping unit.

Made Land, Dredged River Materials

Made land, dredged river materials (Mf) is composed of materials that were dredged from the Delaware River or its tributaries and pumped into extensively diked areas, mostly since 1945. The dredged material ranges from clay to boulders. Boulders, cobbles, gravel, and sand dropped out of the water to form a cone at the discharge pipe. Silt and clay remained in suspension for some time and gradually settled in lower positions over the diked area. Because, generally, several pumpings were made and the discharge pipe was moved from time to time, the coarse-textured cones are present at numerous places within any one area of this land type. The deposits of silt, very fine sand, and clay are much more extensive than the coarse deposits. The fine material is generally gray because it has not had time to oxidize. In some places the surface layer has turned brown to a depth of a few inches. Some mottles of high chroma have been formed.

The fill material ranges from 10 to 20 feet in thickness. It was placed to cover soils of several different kinds, including Tidal marsh, Peat, Muck, and some of the upland sandy soils. Many of the fills are recent and have not settled completely.

After draining, drying, and settling, the filled areas offer some possibility for farming and, eventually, for commercial and industrial uses. They have low organic matter content and are subject to wind erosion. Waterholding capacity is high. Permeability is moderately slow. Frost heaving is severe. Stability of building foundations is likely to be poor. The percolation rate probably is too slow to permit use of these areas for septic fields. (Capability unit IIIw-20; not classified in a woodland suitability group)

Made Land, Sanitary Land Fill

Made land, sanitary land fill (Mg) is composed of areas on which refuse has been dumped. In the normal dumping practice, an excavation is made, refuse is dumped, and the refuse is covered from time to time with soil material. The refuse contains many materials, including metal, glass, concrete, stone, wood, garbage, and other household and industrial waste. Differential settling takes place. Methane gas and hydrogen sulfide are likely to be formed during the anaerobic decomposition of organic refuse. This land type is not classified in a capability unit or a woodland suitability group.

Describing Mapping Units That Are Associations

Lewisville association, 1 to 3 percent slopes (LwB).--The soils in this association are mostly Lewisville loam or clay loam, but Norge fine sandy loam or loam makes up about 15 to 30 percent. These well-drained, gently sloping soils are about 66 inches thick. They are underlain by sandy clay and are cut by a few small gullies.

Mapped areas of this association include small areas of Payne clay loam, 1 to 3 percent slopes, and about 5 percent of Lewisville association, 3 to 5 percent slopes, eroded.

These soils are suited to cultivated crops, but protection from erosion is needed. They warm up early in spring but are somewhat droughty in hot, dry weather. (Capability unit IIe-1: Rolling Blackland range site)

Lewisville association, 3 to 5 percent slopes, eroded (LwC2).--The dominant soil in this association is Lewisville loam, but about 15 to 20 percent is a soil that is similar to Lewisville loam but has more sand in the subsoil than that soil. These moderately sloping, well-drained soils are on convex slopes and are about 60 inches thick. They are underlain by sandy clay. Erosion has removed part of the original surface soil and has caused a few gullies to form. Mapped areas of this association include about 5 percent Lewisville association, 1 to 3 percent slopes, and about 5 percent Lewisville silty clay, 3 to 5 percent slopes, eroded.

These soils are fairly well suited to cultivated crops, but good management of crop residue and cover crops is needed to control erosion. The soils are somewhat droughty in hot, dry weather and are best suited to small grains, sweetclover, and other cool-season crops. (Capability unit IIIe-2; Rolling Blackland range site)

Use and Management of Soils

This section explains the system of capability classification used by the Soil Conservation Service and gives the estimated yields of the principal crops and pasture grasses grown in the county. It also contains information on the use and management of the soils in the survey area as woodland, for wildlife, in engineering, for recreation, and for town and country planning.

To determine the capability classification of a given soil, refer to the "Guide to Mapping Units" at the back of this survey. The use and management of individual soils for crops and pasture are discussed in the section "Descriptions of the Soils" rather than by capability units. In the subsection on woodland, a table lists the woodland suitability groups into which the soils have been placed. The subsection on wildlife gives information about the suitability of the soils for the elements of wildlife habitat. In the subsection on engineering, the soils are not grouped but are placed in tables so that properties significant to engineering work can be given readily. In the subsection "Use of the Soils for Recreation," the soils are rated according to their limitations for selected recreational uses. In the subsection "Town and Country Planning," the soils are rated according to their limitations for selected uses.

Use and Management of the Soils

The first part of this section discusses the general principles of management that apply to all of the soils used for farming in _____ County. The second part explains the capability classification system. The third part describes the capability units in the county and discusses the use, suitability, and management requirements for each. In the fourth part, estimated acre yields are given for the principal crops under two levels of management. Next are discussion on the use of soils as woodland, for wildlife, for recreation, and in engineering. Finally, there is a part that gives information about selected uses of soils in town and country planning.

General Principles of Soil Management

Some principles of management are general enough to apply to all the soils suitable for farm crops and pasture throughout the county, though the individual soils or groups of soils require different kinds of management. These general principles of management are discussed in the following paragraphs.

Many soils in the county need lime or fertilizer or both. The amounts needed depend on the natural content of lime and plant nutrients, which are determined by laboratory analyses of soil samples; on the needs of the crop; and on the level of yield desired. Only general suggestions for applications of lime and fertilizer are given in this publication.

Most of the soils of _____ County were never high in content of organic matter, and to build up the content to a high level is not economical. It is important, however, to return organic matter by adding farm manure, leaving plant residue on the surface, and growing sod crops, cover crops, and green-manure crops.

Tillage tends to break down soil structure. It should be kept to the minimum necessary to prepare a seedbed and control weeds. Maintaining the organic-matter content of the plow layer also helps to protect the structure.

On wet soils such as _____ silt loam, yields of cultivated crops can be increased by open ditch drainage or tile drainage. Tile drains are costly to install, but they generally provide better drainage than open ditches. Soils that have a fragipan are difficult to drain; they can usually be drained better by open ditches than by tile. Open ditch drainage is more effective if the ditches intercept the water as it moves horizontally on top of the fragipan. For drainage by either tile or open ditches, suitable outlets are needed.

All of the gently sloping and steeper soils that are cultivated are subject to erosion. Runoff and erosion occur mostly while a cultivated crop is growing or soon after one has been harvested. On erodible soils such as _____ silt loam, 2 to 6 percent slopes, a cropping system that controls runoff and erosion is needed, in combination with other erosion control practices. As used here, cropping system refers to the sequence of crops grown, in combination with management that includes minimum tillage, mulch planting, use of crop residue, growing of cover crops and green-manure crops, and use of lime and fertilizer. Other erosion control practices are contour cultivation, terracing, contour stripcropping, diversion of runoff, and use of grassed waterways. The effectiveness of a particular combination of these measures differs from one

soil to another, but different combinations can be equally effective on the same soil. The local representative of the Soil Conservation Service will assist you in planning an effective combination of practices.

Pasture is effective in controlling erosion on all but a few of the soils that are subject to erosion. A high level of pasture management is needed on some soils to provide enough ground cover to keep the soil from eroding. A high level of pasture management provides for fertilization, control of grazing, selection of pasture mixtures and other practices that are adequate for maintaining good ground cover and forage for grazing. Grazing is controlled by rotating the livestock from one pasture field to another and providing rest periods for the pasture after each grazing period to allow for regrowth of the plants. It is important on some soils that pasture mixtures be selected that will require the least amount of renovation to maintain good ground cover and forage for grazing.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels; the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in / / are described and suggestions for the use and management of the soils are given.

PWM
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5.0

Management by Capability Units

The capability units in _____ County are described in this part of the survey and suggestions are given for the use and management of the soils in the unit. To find the capability classification of any given mapping unit, refer to the "Guide to Mapping Units" at the back of this survey.

Outline for the Description and

Interpretation of the Capability Unit

I. Name of capability unit.

II. Give properties of the soils in the capability unit that readers must consider if they are to make sound predictions on the potential use and improved management of the soils. If the capability unit contains one or more kinds of soil having characteristics that differ significantly from those of other soils in the group, identify these by describing the soils very briefly without naming them.

III. Name plants that are suited, that is, row crops, small grains, hay crops, and pasture plants. In most surveys, practices such as those needed to provide drainage, erosion control, flood control, and improved fertility or soil structure probably can be given in the writeup for each capability unit.

If the soil survey will not contain sections on woodland, discuss suitability of the soils for these uses.

If the survey area has about as many capability units as mapping units, discuss use and management only in the description of the mapping unit. Also, consider discussing use and management only in the mapping unit description if (a) there are not more than 50 mapping units in the survey area, or (b) the number of mapping units in the capability units averages less than three. The Soil Correlator of Manuscripts in the RTSC should be consulted in borderline situations.

If the manuscript contains soil management at the mapping unit level, instead of by capability units, then a section that gives an explanation of the capability classification and a descriptive list of all the capability classes, subclasses, and units in the survey area should be provided. An example of such a descriptive list is shown on pages 59 through 62 of this supplement.

CAPABILITY UNIT IIe-1

This capability unit consists of well-drained, eroded soils on broad, very gently sloping interstream divides. These soils have a plow layer of very friable sandy loam 6 to 8 inches thick. Their subsoil is friable to firm sandy clay or clay to clay loam. The effective root depth is 36 to 58 inches or more. Depth to bedrock ranges from 6 to 15 feet.

These soils are moderate to low in natural fertility and contain little organic matter. Surface runoff and the rate of infiltration are both medium. The available water capacity is moderate. These soils are strongly acid. Further erosion is a slight to moderate hazard.

About 78 percent of the acreage is cultivated, and about 8 percent is in pasture. The rest is in trees.

These soils are well suited to cotton, corn, small grains, soybeans, peaches, pecans, truck crops, and nursery crops. Pasture and hay crops to which they are well suited are all the locally grown grasses; lespedeza; crimson, Amclo, and white clover; millet; and grain sorghum.

Erosion is the chief hazard if these soils are cultivated. The steepness and length of the slopes, and the practices used to control erosion, influence the kind of cropping system needed to keep losses of soil and water within tolerable limits. Practices that help to control erosion and conserve moisture are contour tillage, terracing, contour stripcropping, and vegetating of waterways. These soils are well suited to sprinkler irrigation.

CAPABILITY UNIT VIe-1

This capability unit consists of deep, well-drained, moderately eroded and severely eroded soils on uplands. The slopes range from 6 to 25 percent. In most places the plow layer of the moderately eroded soils is friable sandy loam or coarse sandy loam and the plow layer of the severely eroded soils is friable clay loam or sandy clay loam. The subsoil is predominantly yellowish-red to dark-red sandy clay loam to clay. The effective depth to which plants can penetrate is generally about 36 inches, but it is greater in some places. Bedrock is at a depth of more than 6 feet.

Natural fertility and the content of organic matter are low. The moderately eroded soils are in fair to good tilth, and the severly eroded ones are in poor tilth. Permeability and the available water capacity are moderate, and the rate of infiltration is medium to slow. Surface runoff is medium to very rapid. The severely eroded soils can be tilled only within a narrow range of moisture content without becoming cloddy or puddled. The hazard of further erosion is severe.

Much of the acreage has been cultivated in the past, but about 70 percent is now wooded. About 15 percent is in pasture, 8 percent is cultivated, and the rest is idle.

The soils of this unit are suitable for pasture, hay, or trees, but they are generally not suitable for cultivation. All of the locally grown grasses and legumes, except alfalfa, are suitable. Establishing a stand is difficult, however, because of the strong slopes, severe hazard of further erosion, and heaving in winter.

Capability grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit. The eight classes in the capability system and the subclasses and units in County (or Area) are described in the list that follows. The unit designation for each soil is given in the Guide to Mapping Units.

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Note to Authors:

In the list that follows, the definitions of the classes and subclasses should be copied as they are stated. The capability units, however, will need to be described according to the properties of the soils that you have placed in your capability units.

Class I: Soils have few limitations that restrict their use (no subclasses).

Capability unit I-1.--Nearly level, deep, well drained, silt loam soils formed in material weathered from limestone.

Capability unit I-2.--Nearly level, deep, well drained, sandy loam soils formed in acid sediments.

Class II: Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe: Soils subject to moderate erosion unless protected.

Capability unit IIe-1.--Gently sloping, deep, well drained, silt loam soils formed in material weathered from limestone.

Capability unit IIe-2.--Gently sloping, deep, moderately well drained, silt loam soils with a fragipan, formed in acid sediments.

Subclass IIw: Soils moderately limited because of excess water.

Capability unit IIw-1.--Nearly level, deep, moderately well to somewhat poorly drained, loam and silt loam soils formed in acid sediments.

Capability unit IIw-2.--Nearly level, deep, moderately well to somewhat poorly drained, silt loam soils formed in recent alluvium.

Subclass IIs: Soils moderately limited by droughtiness.

Capability unit IIs-1.--Nearly level to gently sloping, deep, well drained to somewhat excessively drained, loamy sand and gravelly sandy loam soils formed in acid sediments.

Class III: Soils have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe: Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-1.--Moderately sloping, deep, well drained, silt loam soils formed in material weathered from limestone.

Capability unit IIIe-2.--Moderately sloping, deep, well drained, sandy loam soils formed in acid sediments.

Capability unit IIIe-3.--Moderately sloping, deep, moderately well drained, silt loam soils with a fragipan, formed in acid sediments.

Subclass IIIw: Soils severely limited for cultivation because of excess water.

Capability unit IIIw-1.--Nearly level, deep, somewhat poorly drained, silt loam soils formed in acid sediments.

Capability unit IIIw-2.--Nearly level, deep, poorly drained, silt loam soils formed in recent alluvium.

Capability unit IIIw-3.--Nearly level to gently sloping, deep, somewhat poorly drained loam and silt loam soils formed in old, clayey marine sediments.

Subclass IIIs: Soils severely limited for cultivation by droughtiness.

Capability unit IIIs-1.--Nearly level to gently sloping, deep, somewhat excessively drained, loamy sand soils formed in acid sediments.

Class IV: Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Subclass IVe: Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-1.--Moderately sloping to strongly sloping, well drained, loam, channery loam, and silty clay loam soils formed in material weathered from acid rocks.

Capability unit IVe-2.--Moderately sloping, deep, somewhat poorly drained, silty clay loam soils formed in old, clayey marine sediments.

Subclass IVw: Soils very severely limited by excess wetness.

Capability unit IVw-1.--Nearly level to moderately sloping, deep to moderately deep, very poorly drained to somewhat poorly drained, silt loam soils formed in material weathered from limestone.

Subclass IVs: Soils very severely limited by droughtiness.

Capability unit IVs-1.--Moderately sloping, deep, somewhat excessively drained, loamy sand soils formed in acid sediments.

Class V: Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, woodland, or wildlife habitat.

Subclass Vw: Soils too wet for cultivation; drainage generally not feasible.

Capability unit Vw-1.--Nearly level, deep, poorly drained, silt loam soils formed in material weathered from acid rocks.

Class VI: Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, woodland, or wildlife habitat.

Subclass VIe: Soils severely limited, chiefly by risk of erosion unless protective cover is maintained.

Capability unit VIe-1.--Strongly sloping to steep, deep to moderately deep, well drained to excessively drained soils of variable textures; formed in material weathered from acid rocks.

Subclass VIw: Soils severely limited by excess water; generally unsuitable for cultivation.

Capability unit VIw-1.--Alluvial land subject to frequent flooding.

Capability unit VIw-2--Gently sloping, deep, poorly drained, silt loam soils formed in material weathered from acid rocks.

Subclass VIs: Soils generally unsuitable for cultivation and limited for other uses by their low available moisture capacity, stones, or other features.

Capability unit VIs-1.--Gently sloping to moderately sloping, deep, well drained, very rocky loam soils formed in material weathered from limestone.

Capability unit VIs-2.--Gently sloping to strongly sloping, moderately deep to deep, moderately well drained to somewhat excessively drained, very stony soils formed in material weathered from acid rocks.

Class VII: Soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to grazing, woodland, or wildlife habitat.

Subclass VIIe: Soils very severely limited, chiefly by risk of erosion unless protective cover is maintained.

Capability unit VIIe-1.--Strongly sloping to steep Loamy and clayey land.

Capability unit VIIe-2.--Strongly sloping, moderately deep, somewhat excessively drained channery loam soils formed in material weathered from acid, micaceous rocks.

Subclass VIIw: Soils very severely limited by excess water.

Capability unit VIIw-1.--Swamp areas mostly heavily wooded.

Subclass VIIs: Soils very severely limited by low available moisture capacity, stones, or other soil features.

Capability unit VIIs-1.--Steep, moderately deep to deep, well drained to excessively drained, very stony soils formed in material weathered from acid and basic rocks.

Capability unit VIIs-2.--Strongly sloping to steep, shallow to moderately deep, well drained, channery silty clay loam soils formed in material weathered from serpentine rocks.

Class VIII: Soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

Subclass VIIIw: Extremely wet marshy land.

Capability unit VIIIw-1.--Tidal marsh.

Subclass VIIIs: Stony land, coastal beaches, and other areas that have little potential for commercial crop production.

Capability unit VIIIs-1.--Stony land, steep.

Capability unit VIIIs-2.--Coastal beaches.

Capability unit VIIIs-3.--Clay pits, Mine dumps and quarries, and Sand and gravel pits.

FOR EXAMPLE ONLY

Estimated Yields

Table ___, beginning on page ___, shows estimates of yields, under two levels of management, of the principal crops grown in _____ County.

In columns A are yields to be expected under average management. Average management is defined as follows:

For cultivated crops:

1. Surface and internal drainage are improved, but not enough to provide optimum growing conditions where natural drainage is restricted.

2. Moderate amounts of lime and fertilizer are applied, but a more adequate program of soil testing is needed.

3. Most crop residue is returned to the soil. If low-residue crops are grown, organic matter is supplied by growing cover crops and applying manure or other organic material.

4. Seedbed preparation is either inadequate or excessive, and the soil may be worked when either too wet or too dry.

5. Weeds and insects are not adequately controlled.

6. Crop variety, seed quality, and plant population are not considered for a specified soil or location.

7. Control of erosion is inadequate.

For hay and pasture grasses:

1. Drainage is improved, but not enough to provide optimum growing conditions where natural drainage is restricted.

2. Moderate amounts of lime and fertilizer are applied, but a more adequate program of soil testing is needed.

3. Reseeding is usually delayed until after the legumes have disappeared from the forage stand and the grasses show serious nitrogen deficiency.

4. Grass-legume stands are of medium quality, crop variety and seed quality or quantity are not considered, and seedbed preparation may be inadequate.

5. Field operations are usually timely.

6. The entire pasture is grazed, and it may be overgrazed late in summer and in fall.

7. Runoff and erosion on steep slopes are not controlled.

Yields given in columns B are those to be expected under high-level management. High-level management is defined as follows.

For cultivated crops:

1. Surface and internal drainage provide optimum growing conditions where natural drainage is restricted.

2. Lime, phosphate, potash, nitrogen, and other elements are applied according to crop needs and the needs indicated by soil tests.

3. All crop residue is returned to the soil. If low-residue crops are grown, organic matter is supplied by growing cover crops and by applying manure or other organic material.

4. Seedbed preparation is limited to that needed for crop production. Tillage is avoided when the soils are wet, and spring tillage is delayed until planting time. If plowed in fall, fields are left rough in winter. Green-manure crops are plowed under no earlier than October 1 of the seeding year.

5. Weeds and insects are adequately controlled.

6. Crop variety, seed quality, and plant population are considered for a specified soil and location.

7. Erosion is kept within tolerated limits.

8. Field operations are usually timely.

For hay and pasture grasses:

1. Surface and internal drainage provide optimum growing conditions.

2. Lime and fertilizer are applied at seeding time according to crop needs and the needs indicated by soil tests, and also are applied as topdressing as needed.

3. Stands are reseeded and reestablished regularly.

4. Grass-legume stands are of high quality, and crop variety is considered for a specified soil and location.

5. Haymaking operations are timely.

6. Grazing is deferred and rotated as needed.

Special Crops

A sizable acreage in Erie County is used to produce special field crops, vegetable crops, and fruit crops. Sugar beets and sweet corn are the main special field crops. Fruits and vegetables are grown for sale to canneries and for sale as fresh produce at roadside stands. Most of the acreage used for these special crops consists of a few kinds of soils. Yields depend as much on the weather as on any other single factor. Favorable weather that permits planting early in spring increases the returns from peas, early cabbage, sweet corn, snap beans, and sugar beets. Because of their high value per acre, these special crops warrant intensive management.

Sugar beets.--In 1964 sugar beets were grown on 661 acres in Erie County. Sugar beets are grown on various soils, ranging from the sandy Arkport and Galen soils to the clayey Toledo soils, but the largest acreage is grown on medium-textured to fine-textured, poorly drained soils. Such soils are well supplied with organic matter and plant nutrients, including manganese, boron, and zinc, all of which are minor elements that are critical for beets.

Sweet corn.--Sweet corn is the vegetable grown on the largest acreage in Erie County. In 1964 it was harvested from 2,265 acres. Most of the corn is grown for the canning factory, but a considerable amount is also sold as fresh produce. A small amount is used for seed. Sweet corn can be grown about anywhere that field corn can be grown. The largest acreage used for sweet corn consists of Arkport, Galen, Kibbie, Sisson, and Tuscola soils. Because sweet corn is harmed by extended periods of dry weather, good yields cannot be expected on Berks, Castalia, or Casco, very flaggy subsoil variant soils, or on other shallow, droughty soils. Good drainage, either natural or artificial, is needed. Sandy soils are most suitable for early varieties, but soil texture is less important for late varieties.

Popcorn.--In 1964 more than 403 acres was used to grow popcorn. Popcorn needs soil much like that on which field corn is grown, but because of the smaller size of the plant, it extracts a smaller amount of nutrients from the soil. It is grown on various soils mainly near Milan and Huron.

Tomatoes.--In 1960 tomatoes were grown on 352 acres in Erie County. Part of the crop is canned, and part is sold as fresh produce. Tomatoes are grown on various soils, ranging from the sandy, light-colored Arkport soils to the clayey, dark-colored Toledo soils. The sandier soils are the most suitable for early varieties, but soil texture is relatively unimportant for the late varieties. Good drainage, either natural or artificial, is not needed because the root system is not moisture tolerant. In the sandy area around Milan, protecting early tomatoes from damage by blowing sand is a major problem.

Melons.--In 1964 melons were grown on 98 acres in Erie County. Melons are grown mainly on Arkport, Galen, Oakville and Oshtemo soils and other well-drained, coarse-textured soils. They can be grown on fairly acid soils.

Their needs for fertilizer are not greatly different from those of field crops. All the well-drained, sandy soils in the county are suited to melons. Milan is the center of the melon-growing area.

Lima beans.--In 1964 lima beans were grown on 153 acres. Lima beans are grown on various soils but most extensively on the medium-textured soils that are high in content of organic matter. They are a late crop and can be grown on wetter soils than the early vegetable crops.

Cabbage.--In 1964 cabbage was grown on 517 acres in Erie County. Almost the entire crop was made into sauerkraut. Cabbage is grown on various soils but most extensively on the Arkport, Galen, Metea, Sisson, and Tuscola soils and others that are nearly level, medium textured to coarse textured, and well drained to moderately well drained. They do best on soils that are nearly neutral. Sandy soils are the most suitable for early varieties, but other soil textures are as suitable for late varieties. Darroch and Wilmer soils and other wet soils that are high in organic-matter content are well suited if adequately drained. Yields from Bogart, Chili, and other acid soils are good if large amounts of lime are applied. The response to irrigation is good.

Potatoes.--In 1960 potatoes were grown on 246 acres in Erie County. Potatoes need loose, friable soils that are well supplied with plant nutrients. They are well suited to most of the sandy and gravelly, well-drained soils in the county and are successfully grown on Sisson and Tuscola soils, Warners muck, and other soils. Scab-resistant varieties can be grown on the calcareous Warners muck. Generally, yields are not good on Allis or Mahoning soils or others that are dense and compact.

Other vegetables.--Peppers, asparagus, pumpkins, squash, snap beans, cucumbers, cauliflower, and peas are also grown in Erie County. Each one of these crops is grown on between 30 and 60 acres. Typically, the vegetables from one or two large acreages are grown for canning factories, and those from the numerous small acreages are marketed as fresh produce. Production is concentrated along Lake Erie from Huron west, and in the Milan area. The vegetables are grown mainly on Sisson, Tuscola, Kibbie, Oshtemo, Digby, Arkport, and Galen soils. Good drainage, either natural or artificial, and a reaction that is slightly acid to neutral are the main needs of these crops. Many need irrigation in a dry season.

Fruit crops.--The number of fruit-producing trees and vines had been decreasing since 1930, but according to a tree census taken in 1964, there has been a slight increase in the number of fruit trees. Since dwarf trees and early varieties have been available, the acreage of fruit trees has been expanded and more old orchards have been replaced.

Deep, porous, well-drained soils are best suited, because fruit trees need a deep root zone. Good air drainage is a necessity. Orchards of apples, peaches, and cherries are concentrated on the gravelly beach

ridges in the eastern part of the county and on the Chili, Oshtemo, Bogart, and Belmore soils. There were once large orchards on the Berks and Loudonville soils (fig. 5), and on others that are moderately deep

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Figure 5.--Apple orchard on well-drained Loudonville loam.

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over sandstone and have good air drainage, but most of these orchards either are now deteriorating or have been abandoned. Among the soils that are poorly suited to fruit trees are a few soils that are too acid; Romeo soils and other shallow soils; and Allis and Fries soils and other wet, dense soils that do not have adequate aeration.

A very large acreage in Erie County is well suited to grapes, a crop that does well on soils that, in general, are poorly suited to other crops. They can be grown on the poorly drained, acid Allis soils in the southern part of Vermilion Township; on Pyrmont soils on Kelleys Island; and on Fulton soils in the Venice area. Grape production has declined, primarily because of labor costs, not because of the soils.

Strawberries are grown on about 50 acres in Erie County. Strawberries are suited to many soils but seem to do best on medium-textured to moderately coarse textured, acid soils. Intensive management is needed.

Irrigation

Sprinkler irrigation is used successfully for vegetable crops and berry crops, which have a high per-acre value. The suitability of the soil for these crops and the availability of water for irrigation are important considerations in determining whether irrigation is feasible. Only soils in Erie County that have slopes of less than 6 percent are well suited for irrigation. The features affecting the use of soils for irrigation are discussed in the section "Engineering Interpretations" and are shown for each soil in table 5, which begins on page 42.

The lack of good sources of water limits irrigation in some parts of the county. Most irrigation water comes from farm ponds or from deep wells. Using stream water would increase pumping costs. Streams that have a dependable flow at the time of year when the need for water is greatest are either in areas where the soils are not suitable for irrigation or at elevations considerably lower than those of the soils that could be irrigated.

Soils that are suitable for irrigation and need only a minimum of artificial drainage are Arkport, Bogart, Chili, Eel, Lobdell, Metea, Oakville, Oshtemo, and Sisson soils. Also suitable are Belmore soils that have loam texture; Galen soils, not those that have a limestone substratum or a shale substratum; and Tuscola soils.

Soils that can be used for irrigation if adequate artificial drainage is provided are Darroch, Del Rey, Digby, Gilford, Haskins, Jimtown, Orrville, Rawson, Rimer, Shinrock, Shoals, and Wilmer soils. Also suitable if adequately drained are Colwood soils that have fine sandy loam and silt loam texture; Kibbie soils that have fine sandy loam and silt loam texture, but not the moderately shallow variant; and Millgrove soils that have loam texture.

Fulton and Toledo soils and some other fine textured to moderately fine textured soils can be irrigated if good structure is maintained. Some sandy soils that have slopes of as much as 12 percent can be irrigated successfully if erosion is controlled. Some soils that have slopes of more than 6 percent can be made suitable for irrigation by reshaping.

Uses of Soils for Woodlands

The soils of the / County or Area/ have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management where the vegetation on them is similar, and that have the same potential production.

Each woodland group is identified by a three-part symbol, such as 1o1, 2w1, or 3w3. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1, very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determination of average site index. Site index of a given soil is the height, in feet, that the taller trees of a given species reach in a natural, essentially unmanaged stand in a stated number of years. Site index can be converted into approximate expected growth and yield per acre in cords and board feet. For / County or Area/, conversions of average site index into volumetric growth and yield are based on research as follows: Upland oaks ( ); yellowpoplar ( ); sweetgum ( ); and shortleaf pine ( ).

The second part of the symbol identifying a woodland group is a small letter. In this survey w, s, r, and o are used. Except for the o, the small letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for trees. The letter o shows that the soils have few limitations that restrict their use for trees. The letter w means excessive wetness, either seasonal or all year. The soils have restricted drainage, have high water tables, or are subject to flooding. The letter s stands for sandy soils that have little or no difference in texture between surface layer and subsoil (B horizon). These soils are moderately to severely restricted for woodland use. They have low available water capacity and are low in available plant nutrients. The letter r shows that the main limitation is steep slopes and that there is hazard of erosion and possibly limitations to use of equipment. In this county r is used if slopes are greater than 15 percent.

The last part of the symbol, another number, differentiates woodland suitability groups that have identical first and second parts in their identifying symbol. Soils in woodland group 3w1, for example, require somewhat different management than soils in group 3w2.

In table / / each woodland suitability group in the county is rated for various management hazards or limitations. These ratings are slight, moderate, or severe, and they are described in the following paragraphs.

Equipment limitations depend on soil characteristics that restrict or prohibit the use of harvesting equipment, either seasonally or continually. Slight means no restrictions in the kind of equipment or time of

year it is used; moderate means that use of equipment is restricted for 3 months of the year or less; severe means that special equipment is needed and that its use is severely restricted for more than 3 months of the year.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions when plant competition is assumed not to be a factor. Slight means a loss of 0 to 25 percent; moderate means a loss of 25 to 50 percent; and severe means a loss of more than 50 percent of the seedlings. It is assumed that seed supplies are adequate.

Plant competition is the degree to which undesirable plants invade opening in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. Conifers and hardwoods are rated separately in table / /. Slight means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development; moderate means that competition delays natural or artificial establishment and growth rate, but does not prevent the development of fully stocked normal stands; severe means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and maintenance practices, such as burning, spraying, disking, or girdling, are used.

Windthrow hazard depends on the soil characteristics that enable trees to resist being blown down by wind. Slight means that most trees withstand the wind; moderate means that some trees are expected to blow down during excessive wetness and high wind; severe means that many trees are expected to blow down during periods when the soil is wet and winds are moderate or high.

Table / / lists suitable species to favor in existing stands and suitable species for planting. The estimated site index in table / / is the height, in feet, that the tallest trees reach at 50 years of age on the soils of each group.

No. 2 FOR EXAMPLE ONLY

TABLE 3.—*Yields per acre from upland oaks, yellow-poplar, and Virginia pine in even-aged fully stocked, natural stands*

[All numbers are rounded to the nearest whole number. Dashes indicate that data was not available or does not apply]

Site index	Age of stand	Merchantable volume				
		Upland oaks		Yellow-poplar		Virginia pine
	Years	*Cords*[1]	*Bd. ft.*[2]	*Cords*[3]	*Bd. ft.*[2]	*Cords*[4]
40	30	3	100	------	------	----------
	50	12	1, 400	------	------	----------
	70	21	4, 250	------	------	----------
50	30	6	350	------	------	[5] 11
	50	19	3, 250	------	------	[5] 18
	70	30	8, 150	------	------	----------
60	30	10	850	10	1, 000	19
	50	26	6, 300	21	5, 600	31
	70	39	12, 800	------	------	----------
70	30	15	1, 750	15	2, 650	33
	50	33	9, 750	31	11, 400	54
	70	47	17, 700	------	------	----------
80	30	20	3, 350	21	5, 500	57
	50	41	13, 750	41	17, 620	93
	70	56	23, 100	------	------	----------
90	30	------	------	27	8, 710	----------
	50	------	------	52	24, 400	----------
	70	------	------	------	------	----------
100	30	------	------	32	12, 150	----------
	50	------	------	62	32, 150	----------
	70	------	------	------	------	----------

[1] Unpeeled volume of merchantable stems to a top diameter of 4 inches, outside bark.

[2] According to International rule, 1/8 inch, for stems to a top diameter of 5 inches, inside bark.

[3] Peeled volume of all trees 5 inches or more in diameter breast high and to a top diameter of 3 inches, inside bark. Based on conversion factor of 86.4 cubic feet of solid wood per cord.

[4] Merchantable volume of all stems 4 inches or more in diameter breast high and to a top diameter of 4 inches, outside bark, in stands of 100 percent density. Based on a conversion factor of 85 cubic feet equals 1 standard cord.

[5] Extrapolated value.

Use of Soils for Wildlife

The production of a wildlife species depends largely on the amount and distribution of food, shelter, and water. If any of these elements is missing, inadequate, or inaccessible, the species is absent or scarce. The kinds of wildlife that live in a given area and the number of each kind are closely related to land use, to the resulting kinds and patterns of vegetation, and to the supply and distribution of water. These, in turn, are generally related to the kinds of soils.

Habitat for wildlife normally can be created or improved by planting suitable vegetation, by properly managing the existing plant cover, by fostering the natural establishment of desirable plants, or by using a combination of these measures.

This subsection rates the soils of _____ County according to their suitability for seven elements of wildlife habitat and for three general kinds of wildlife habitat. Then it explains the elements and the general kinds of wildlife habitat and explains the ratings.

Uses of Suitability Ratings

The suitability ratings in this subsection can be used as an aid in _____

1. Planning the broad use of parks, refuges, nature-study areas, and other recreational developments for wildlife.

2. Selecting the better soils for creating, improving, or maintaining specific kinds of wildlife habitat elements.

3. Determining the relative intensity of management needed for individual habitat elements.

4. Eliminating sites that would be difficult or not practical to manage for specific kinds of wildlife.

5. Determining areas that are suitable for acquisition for use by wildlife.

Habitat Elements

Each soil is rated in table ___ according to its suitability for various kinds of plants and other elements that make up wildlife habitat. The seven elements considered important are as follows:

Grain and seed crops.--These crops include such seed producing annuals as corn, sorghum, wheat, barley, oats, millet, buckwheat, cowpeas, and other plants commonly grown for grain or for seed. The major soil properties affecting this habitat element are effective rooting depth, available

water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Domestic grasses and legumes.--Making up this group are domestic perennial grasses and herbaceous legumes that are established by planting and furnish wildlife cover and food. Among the plants are bluegrass, fescue, brome, timothy, orchardgrass, reed canarygrass, clover, and alfalfa. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, slope, surface stoniness, hazard of flooding, and texture of the surface layer and subsoil.

Wild herbaceous plants.--In this group are native or introduced perennial grasses and weeds that generally are established naturally. They include bluestem, quackgrass, panicgrass, goldenrod, wild carrot, nightshade, and dandelion. They provide food and cover principally to upland forms of wildlife. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, natural drainage, surface stoniness, hazard of flooding or ponding, and texture of the surface layer and subsoil.

Hardwood trees.--This element includes nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They are generally established naturally but may be planted. Among the native kinds are oak, cherry, maple, poplar, apple, hawthorn, dogwood, persimmon, sumac, sassafras, hazelnut, black walnut, hickory, sweetgum, bayberry, blueberry, huckleberry, blackhaw, virburnum, grape, and briers. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, and natural drainage.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crabapple, multiflora rose, highbush cranberry, and silky cornel dogwood are some of the shrubs that generally are available and can be planted on soils that are rated well suited. Hardwoods that are not available commercially can commonly be transplanted successfully.

Coniferous plants.--This element consists of cone-bearing evergreen trees and shrubs that are used by wildlife primarily as cover, though they also provide browse and seeds or fruit-like cones. Among them are Norway spruce, Virginia pine, loblolly pine, shortleaf pine, pond pine, Scotch pine, redcedar, and Atlantic whitecedar. Generally, the plants are established naturally in areas where cover of weeds and sod is thin but they may also be planted. The major soil properties affecting this habitat element are effective rooting depth, available water capacity, and natural drainage.

Wetland plants.--Making up this group are wild, herbaceous, annual and perennial plants that grow on moist to wet sites exclusive of submerged or floating aquatics. They produce food and cover extensively

used mainly by wetland forms of wildlife. They include smartweed, wild millet, bulrush, sedges, barnyard grass, pondweed, duckweed, duckmillet, arrow-arum, pickeralweed, waterwillow, wetland grasses, wildrice, and cattails. The major soil properties affecting this habitat element are natural drainage, surface stoniness, slope, and texture of the surface layer and subsoil.

Shallow water areas.--These are areas of shallow water, generally not exceeding five feet in depth, near food and cover for wetland wildlife. They may be natural wet areas, or those created by dams or levees, or by water-control devices in marshes or streams. Examples of such developments are wildlife ponds, beaver ponds, muskrat marshes, waterfowl feeding areas, and wildlife watering developments. The major soil properties affecting this habitat element are depth to bedrock, natural drainage, slope, surface stoniness, and permeability. Natural wet areas that are aquifer fed are rated on the basis of drainage class without regard to permeability. Permeability of the soil would apply only for those non-aquifer areas with a potential for development, and water is assumed to be available offsite.

General Kinds of Wildlife Habitat

Table ___ rates the soils according to their suitability for three general kinds of wildlife habitat in the county--openland, woodland, and wetland wildlife.

Openland wildlife.--Examples of openland wildlife are quail, pheasant, meadowlark, field sparrow, dove, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their home in areas of cropland, pasture, meadow, and lawns and in areas overgrown with grasses, herbs, shrubs, and vines.

Woodland wildlife.--Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrush, vireo, scarlet tanager, gray and red squirrels, gray fox, white-tailed deer, raccoon, and wild turkey. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife.--Ducks, geese, rails, herons, shore birds, and muskrat are familiar examples of birds and mammals that normally make their home in wet areas, such as ponds, marshes, and swamps.

Each rating under "General Kind of Wildlife Habitat" in table ___ is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, domestic grasses and legumes, wild herbaceous upland plants, and either hardwood woody plants, or coniferous

woody plants, whichever is most applicable. The rating for woodland wildlife is based on the ratings listed for domestic grasses and legumes, wild herbaceous upland plants, and either hardwood woody plants or coniferous woody plants, whichever is most applicable. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants and shallow water areas.

On soils rated Good, habitat is generally easily created, improved, or maintained. There are few or no soil limitations in habitat management and satisfactory results are well assured.

On soils rated Fair, habitat usually can be created, improved or maintained, but the soils have moderate limitations that affect the creation, improvement, or maintenance of the habitat. A moderate intensity of management and fairly frequent attention may be required to assure satisfactory results.

On soils rated Poor, habitat can usually be created, improved, or maintained; but there are rather severe soil limitations. Habitat management may be difficult, expensive, and require intensive effort. Satisfactory results are questionable.

On soils rated Very Poor, it is impractical to create, improve, or maintain habitat because of the very severe soil limitations. Unsatisfactory results are probable.

Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife.

Note to Authors:

If desired, a brief paragraph might be added to each of the discussions of the kinds of wildlife, summarizing the proportion of the county that was rated good, fair, poor, and very poor for that kind of wildlife.

Engineering Uses of the Soils[1]

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[1] engineer, Soil Conservation Service, assisted in preparation of this section.

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who--

1. Select potential residential, industrial, commercial, and recreation areas.

2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.

3. Seek sources of gravel, sand, or clay.

4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.

5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables ___, ___, and ___, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables ___ and ___, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that are not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering Soil Classification Systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the SCS engineers, Department of Defense, and others, and the AASHO system adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHO system is used to classify soils according to those properties that effect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table ___; the estimated classification, without group index numbers, is given in table ___ for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

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Soil Properties Significant to Engineering

Several estimated soil properties significant in engineering are given in table ___. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table ___.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table ___ in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table ___, but in table ___ the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table ___ do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

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Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in mmhos. per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table ___, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Ratings of soils for corrosivity for concrete are based mainly on soil texture and acidity. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of low means that there is a low probability of soil-induced corrosion damage. A rating of high means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Subsidence is settlement of organic soils or of soils containing semifluid mineral layers. Ratings for subsidence take into account (1) rapid initial loss of elevation resulting from drainage and lowering of the level of the ground water; and (2) later and slower loss of elevation that results from oxidation of organic materials. The maximum possible loss of surface elevation is called potential subsidence.

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Engineering Interpretations of Soils

The estimated interpretations in table ___ are based on the engineering properties of soils shown in table ___, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of _____ County. In table ___, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table ___ lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. Slight means soil properties generally favorable for the rated use or, in other words, limitations that are minor and easily overcome. Moderate means that some soil properties are unfavorable but can be overcome or modified by special planning and design. Severe means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance. For some uses, the rating of severe is divided to obtain ratings of severe and very severe. Very severe means one or more soil properties so unfavorable for a particular use that overcoming the limitations is most difficult and costly and commonly not practical for the rated use.

Soil suitability is rated by the terms good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table ___.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor, and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and

slope and, if the floor needs to be leveled, depth to and condition of bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet as, for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table ___, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table ___ apply only to a depth of about 6 feet, and therefore limitation ratings of slight or moderate may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet but, regardless of that, every site should be investigated before it is selected.

Local roads and streets, as rated in table ___, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and street are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available.

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The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table ___ provide guidance about where to look for probable sources. A soil rated as a good or fair source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or its response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments and dikes require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope, stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion or soil blowing; soil

texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation and the ease of establishing and maintaining vegetation.

Engineering Interpretations of Soils

The estimated interpretations in table ___ are based on the engineering properties of soils shown in table ___, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of _____ County. In table ___, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table ___ lists those soil features not to be overlooked in planning, installation, and maintenance.

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Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Soil properties that most affect highway and road location are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments and dikes require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope, stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

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Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation and the ease of establishing and maintaining vegetation.

Shallow excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries are those that generally require digging or trenching to a depth of less than 6 feet. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Winter grading is affected chiefy by soil features that are relevant to moving, mixing, and compacting soil in road building when temperatures are below freezing.

Soil Test Data

Table ___ contains engineering test data for some of the major soil series in These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction (or moisture-density) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed maximum dry density. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table ___.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when oven-dry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

Use of the Soils for Town and Country Planning

This section of the soil survey provides information on the properties of soils and their effect on selected nonfarm uses of land. It will help community planners, developers, and individual land owners to determine the most suitable use for a particular area. Other useful information can be found on the soil maps and in other parts of the survey, particularly the section "Descriptions of the Soils" and the section "Engineering Uses of the Soils." Although the soil maps and tables serve as a guide and can eliminate some sites from further consideration, they do not supplant direct detailed onsite investigations when a development is being planned. Not considered in this section are location in relation to established business centers or transportation lines and other economic factors that are important and often determine the ultimate use of an area.

Table ____ gives the estimated degree and kinds of limitations for some selected uses. These limitations are rated slight, moderate, or severe. If the rating is moderate or severe, the main limiting property or properties are given. The ratings are based on the degree of the greatest single limitation. For example, if flooding severely limits the use of a soil in the disposal of sewage effluent from septic tanks, the limitation is rated severe, though the soil is well suited to that use in all other respects. A rating of slight indicates that the soil has properties favorable for the rated use. Soil limitations are minor and can be easily overcome. Good performance and low maintenance can be expected on the soil. A rating of moderate indicates that the soil has properties moderately favorable for the rated use. The limitations can be overcome or modified with special planning, design, or maintenance. During some seasons of the year the performance of the structure or other planned use may be somewhat less desirable than for soils with a slight limitation. A rating of severe indicates that the soil has one or more unfavorable properties for the rated use. Limitations are difficult and costly to modify or overcome, requiring major soil reclamation, special design, or intense maintenance. Some soils rated severe can be improved by reducing or removing the soil feature that limits its use. In most situations it is difficult and costly to alter the soil or design a structure to compensate for soil limitations that are severe.

A rating of very severe indicates that the soil has one or more soil features so unfavorable for the particular use that to overcome the limitation is very difficult and expensive. Reclamation is extremely difficult requiring the soil material to be removed, replaced, or completely modified. For the most part, these kinds of soil are not used for the purpose rated.

Discussed in the following paragraphs are the properties considered in rating the limitations to each of the uses given in table ___.

Septic tank absorption fields.--The main limiting features of soils for this use are restricted permeability, steepness of slope, insufficient depth to bedrock, the presence of a seasonal high water table, flooding, and underlying cavernous limestone through the crevices and solution channels of which seepage from effluent can contaminate underground water. The soils rated slight generally have a few or no limitations that affect their use as absorption fields. Those rated moderate may be borderline soils and should be investigated carefully at the exact site of installation. On some of the soils rated moderate, absorption fields need to be larger than on those rated slight. All soils rated severe should be very carefully investigated to determine if an absorption field can be expected to function adequately. The ratings in table ___ refer to year-round use of the soils. Limitations on soils for disposal fields for summer camps or for other part-time uses may be less severe than indicated in the table.

Sewage lagoons.--The limitations of soils in this county if used for sewage lagoons are much the same as those shown for pond reservoir areas, as given in table ____ in the section "Engineering Uses of the Soils." Among the features that mainly control the degree of limitation for sewage lagoons are the incidence of flooding, the amount of seepage, the organic matter content, the permeability of the substratum, depth to rock, depth to water table, and the degree of slope.

Shallow excavations are less than 6 feet deep and pertain to those made for a variety of purposes, such as basements, ditches, graves, and underground cables, pipelines, and sewers. Among the features that affect shallow excavations are soil drainage class, seasonal water table, flooding, slope, soil texture, depth to bedrock, stoniness, and rockiness.

Dwellings (with basements).--The rating of the soils for dwellings excludes buildings that are more than 3 stories in height and that have more than an 8-foot excavation for basements. Also excluded are other buildings with foundation loads in excess of those equal to three story dwellings. Considered in rating the soils are the depth to a high water table, shrink-swell potential, the depth to and the kind of bedrock, soil texture, the degree of slope, potential frost action, the hazard of flooding, and the need for land shaping and other kinds of landscaping. Flooding is a severe hazard for use of a soil as a homesite. Depth to rock, depth to a seasonal high water table, and natural soil drainage, are less severe limitations for buildings that do not have a basement than for those that do. Methods of sewage disposal are not considered in the ratings for dwellings.

Sanitary landfill is an engineering method of disposing of solid wastes on or in the soil by spreading the wastes in thin layers, compacting it to the smallest practical volume and covering the wastes with soil each day in a manner which provides maximum protection of the environment. Soil surveys are a valuable tool in selecting potential alternate sites for a proposed sanitary landfill operation. They are not a substitute for

detailed geologic investigations because soil borings are normally limited to depths of five or six feet. Thus, they do not provide data needed at greater depths.

Soil surveys are especially useful in preliminary determinations of those sites that are not well suited for sanitary landfill operations, thus saving the time and expense of more detailed investigations. They can also indicate those sites where favorable soils are located and where additional investigations appear warranted. The design engineer still needs to determine actual soil conditions to the depth necessary to obtain valid data for design purposes. In table ___, degrees of soil limitations and soil features causing moderate or severe limitations are provided for trench-type landfills, area-type landfills, and cover material in all the soils of the survey area.

1. Trench-type landfill--The soil properties affecting trench-type sanitary landfills are depth to seasonal high water table, soil drainage class, flooding, permeability, slope, soil texture, stoniness, rockiness, and depth to and kind of underlying bedrock. Because many landfill operations use trenches as deep as 15 or more feet, there is need for a geological investigation of the area to determine the potential for pollution of ground water as well as to obtain the design of the sanitary landfill.

2. Area-type landfill--In the area method of landfill operations, refuse is placed in successive layers on the surface of the soil. Daily and final cover material must be imported because no trenches are dug, unless it is for the purpose of obtaining cover material. A final cover of soil material at least two-feet thick is placed over the fill when it is completed. The soil under the proposed site for an area landfill should be investigated to determine the potential for leachates produced by percolating water through the landfill to penetrate and pollute ground water supplies. Even though a soil survey is available, detailed onsite investigation should be made before a final decision is made to use a proposed site. The soil properties affecting area-type landfills are depth to a seasonal high water table, soil drainage class, flooding, permeability, and slope.

3. Cover material (area-type landfill)--As cover material for area-type landfills must be obtained away from the landfill sites themselves, table ___ rates the soils of the survey area for suitability as cover material. Suitability for cover is based on soil properties which reflect workability; the ease of digging, moving, and spreading the soil material over the refuse daily during both wet and dry periods; soil slope, wetness, and thickness of material.

Ratings for local roads and streets pertain to construction and maintenance of improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete; they are expected to carry automobile traffic all year, but not fast-moving, heavy trucks. Properties that affect design and construction of roads and streets are (1) those that affect

the load-supporting capacity and stability of the subgrade, and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth to hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade. Soil limitation ratings in table __ do not substitute for basic soil data or for onsite investigations.

Lawns and landscaping at homesites--It is assumed that enough lime and fertilizer are used for lawn grasses and ornamental plants that are grown. The need for these materials, therefore, is not considered in the ratings for these uses. Suitable soil material is needed in sufficient amounts so that desirable trees and other plants can survive and grow well. Among the important soil properties that determine whether a good lawn can be established are depth of the soil, texture, slope, droughtiness, depth to the water table, and the presence of stones or rocks.

Landscape Plantings

Table 9 is a guide to the selection of trees and shrubs for use in landscaping homes, communities, and recreational areas.

TABLE 9.--Guide for landscape plantings

(The letter "X" indicates species is suitable for the specified use)

DECIDUOUS TREES

Common and botanical names	Drainage suitability range	Shape of mature tree	Uses						Growth rate	Potential height (feet)
			Flower	Fruit	Nut or acorn	Shade	Ornamental	Autumn foliage		
Ash, white (Fraxinus americana)	Good to somewhat poor	Round	---	---	---	X	X	X	Rapid	50+
Basswood (Tilia americana)	Good to somewhat poor	Round	---	---	---	X	---	---	Rapid	50+
Beech (Fagus grandifolia)	Good to somewhat poor	Round	X	---	---	X	X	---	Slow	50+
Birch:										
Paper (Betula papyrifera)	Good to somewhat poor	Round	---	X	---	---	X	X	Rapid	50+
Yellow (B. lutea)	Good to somewhat poor	Round	---	---	---	---	X	X	Moderate	50+
Blackgum (Nyssa sylvatica)	Good to somewhat poor	Oval	---	---	---	X	X	X	Slow	50+
Butternut (Juglans cinerea)	Good and moderately good	Round	---	X	---	X	X	---	Rapid	50+
Catalpa (Catalpa speciosa)	Good to somewhat poor	Round	X	---	---	---	X	---	Moderate	50+
Chestnut, Chinese (Castanea molissima)	Good and moderately good	Round	---	X	---	---	X	---	Rapid	25-50
Crabapple, flowering (Malus spp.)	Good and moderately good	Round	X	---	---	---	X	X	Moderate	15-25
Cucumbertree (Magnolia acuminata)	Good to somewhat poor	Oval	X	---	---	X	X	X	Moderate	50+

Table 9.--Continued

DECIDUOUS TREES

Common and botanical names	Drainage suitability range	Shape of mature tree	Uses						Growth rate	Potential height (feet)
			Flower	Fruit	Nut or acorn	Shade	Ornamental	Autumn foliage		
Dogwood, flowering (Cornus florida)	Good to somewhat poor	Round	X	---	---	---	X	X	Slow	25
Ginkgo (Ginkgo biloba)	Good and moderately good	Oval	---	---	---	X	X	X	Moderate	50+
Hackberry (Celtis occidentalis)	Good and moderately good	Oval	X	---	---	X	X	---	Moderate	25-50
Hawthorn (Crataegus spp.)	Good to somewhat poor	Round	X	---	---	---	X	---		15
Hickory, shagbark (Carya ovata)	Good to somewhat poor	Oval	---	X	---	X	X	---	Slow	50+
Horsechestnut (Aesculus hippocastanum)	Good and moderately good	Round	X	X	---	X	X	---	Moderate	50
Locust:										
Black (Robinia pseudoacacia)	Good and moderately good	Oval	X	---	---	---	---	---	Rapid	50+
Honey (Gleditsia triacanthos)	Good and moderately good	Oval	X	---	---	X	X	---	Rapid	50+
Maple:										
Red (Acer rubrum)	Good to poor	Oval	---	---	---	X	X	X	Rapid	50+
Sugar (A. saccharum)	Good to somewhat poor	Round	---	---	---	X	X	X	Moderate	50+
Mountain-ash:										
American (Sorbus americana	Good to somewhat poor	Oval	X	---	---	---	X	---	Rapid	25-50
European (S. aucuparia)	Good to somewhat poor	Oval	X	---	---	---	X	---	Rapid	25

Table 9.--Continued

DECIDUOUS TREES

Common and botanical names	Drainage suitability range	Shape of mature tree	Uses						Growth rate	Potential height (feet)
			Flower	Fruit	Nut or acorn	Shade	Ornamental	Autumn foliage		
Mulberry, white (Morus alba)	Good to somewhat poor	Round	---	---	---	---	X	---	Rapid	25-50
Oak:										
Pin (Quercus palustris)	Good to somewhat poor	Pyramidal	---	---	X	X	X	X	Moderate	50+
Red (Q. borealis)	Good to somewhat poor	Round	---	---	X	X	X	X	Rapid	50+
White (Q. alba)	Good to moderately good	Round	---	---	X	X	---	---	Slow	50+
Sassafras (Sassafras albidum)	Good and moderately good	Oval	X	---	---	X	X	X	Moderate	25-50
Serviceberry or Juneberry (Amelanchier canadensis)	Good and moderately good	Round	X	---	---	---	---	X	Moderate	25-50
Yellow-poplar (Liriodendron tulipifera)	Good to somewhat poor	Oval	X	---	---	X	---	X	Rapid	50+
Walnut, black (Juglans nigra)	Good and moderately good	Round	---	X	---	---	---	---	Rapid	50+
Willow, weeping (Salix babylonica)	Good to poor	Umbrella	---	---	---	X	X	---	Rapid	25-50

Table 9.--Continued

DECIDUOUS SHRUBS

Common and botanical names	Drainage suitability range	Uses					Potential height (feet)
		Ornamental	Autumn foliage	Screen	Windbreak	Critical area	
Arrowwood (Viburnum dentatum)	Good to poor	X	X	X	---	---	10-15
Autumn olive, cardinal (Elaeagnus umbellata)	Good and moderately good	X	---	X	X	X	10-15
Azalea: Flame (Rhododendron calendulaceum)	Good	X	---	---	---	---	10-15
Wild honeysuckle (R. nudiflorum)	Good	X	---	---	---	---	5-10
Bayberry (Myrica caroliniensis)	Good and moderately good	X	---	---	---	---	6-10
Blackhaw (Viburnum prunifolium)	Good to somewhat poor	---	---	---	---	X	15-20
Coralberry (Symphoricarpos orbiculatus)	Good to somewhat poor	---	---	---	---	X	2-6
Cranberry, highbush (Viburnum trilobum)	Good to somewhat poor	X	---	---	---	---	10-15
Dogwood: Red-osier (Cornus stolonifera)	Good to poor	X	X	X	---	---	10
Silky (C. amomum)	Good to poor	X	X	---	---	---	10
Firethorn, Laland (Pyracantha coccinea lalandi)	Good to moderately good	---	---	---	---	---	10-20

Table 9.--Continued

EVERGREEN TREES

Common and botanical names	Drainage suitability range	Shade tolerant	Uses					Growth rate	Potential height (feet)
			Shade	Ornamental	Windbreak	Screen	Critical area		
Arborvitae:									
American or northern white-cedar (Thuja Occidentalis)	Good to somewhat poor	No	---	X	X	X	---	Slow	50+
Oriental (T. orientalis)	Good to somewhat poor	No	---	X	X	X	---	Slow	50+
Hemlock, eastern (Canada) Tsuga canadensis)	Good and moderately good	Yes	---	X	X	X	---	Moderate	50+
Larch:									
European (Laris decidua)	Good and moderately good	No	X	---	---	---	---	Rapid	50
Japanese (L. leptolepis)	Good and moderately good	No	X	---	---	---	X	Rapid	50+
Pine:									
Austrian (Pinus nigra)	Good and moderately good	No	---	X	X	X	---	Rapid	50+
White (P. strobus)	Good to poor	Yes	---	---	X	X	---	Rapid	50+
Spruce:									
Norway (Picea abies)	Good to somewhat poor	Yes	---	X	X	X	---	Moderate	50+
White (P. glauca)	Good to somewhat poor	Yes	---	---	X	X	---	Moderate	50+

EVERGREEN SHRUBS

Common and botanical names	Drainage suitability range	Uses					Potential height (feet)
		Ornamental	Autumn foliage	Screen	Windbreak	Critical area	
Azalea (Rhododendron spp.)	Good to poor	X	---	---	---	---	5-10
Laurel, mountain (Kalmia latifolia)	Good to somewhat poor	X	---	---	---	---	5-15
Pine, mugo (Pinus mugo)	Good to somewhat poor	X	---	---	---	---	10
Rhododendron (Rhododendron maximum)	Good to somewhat poor	X	---	X	---	---	10-15
Yew, Japanese (Taxus cuspidata)	Good to somewhat poor	X	---	X	X	---	(1/)

1/ Variable.

Table 9.--Continued

DECIDUOUS SHRUBS

Common and botanical names	Drainage suitability range	Uses					Potential height (feet)
		Ornamental	Autumn foliage	Screen	Windbreak	Critical area	
Forsythia (Forsythis spp.)	Good and moderately good	X	---	X	---	X	10-15
Honeysuckle: Amur (Lonicera maacki)	Good and moderately good	X	---	X	---	X	10-15
Tatarian (L. tatarica)	Good and moderately good	X	---	X	---	X	10-15
Privet, Amur (Ligustrum amurense)	Good and moderately good	X	---	X	X	X	15-20
Winterberry (Ilex verticillata)	Good to poor	X	---	---	---	---	10

Town and Country Planning

This survey area is slowly increasing in population and is decreasing in farmland and woodland as residential, commercial, and recreational facilities are developed. Skowhegan, Pittsfield, Madison, and Bingham are rapidly expanding. An effect of this expansion is the increasing need for useful and reliable information about the use of the soils for nonfarm purposes. Recreational facilities are increasing rapidly along the Kennebec River and the many lakes in the survey area.

This section of the soil survey provides information on the properties of soils and their effect on selected nonfarm uses of land. It will help community planners, developers, and individual landowners to determine the most suitable use for a particular area. Other useful information can be found on the soil maps and in other parts of the survey, particularly the section "Descriptions of the Soils" and the subsection "Engineering Uses of Soils."

Table 8 gives the estimated degree and kinds of limitations of soils for some selected uses. These limitations are rated slight, moderate, or severe. If the rating is moderate or severe, the main limiting property or properties are given. The ratings are based on the degree of the greatest single limitation. For example, if flooding severely limits the use of a soil in the disposal of sewage effluent from septic tanks, the limitation is rated severe, though the soil is well suited to that use in all other respects. A rating of slight indicates that the soil has no important limitation to the specific use. Moderate shows that the soil has some limitations to the specified use. These limitations need to be recognized, but they can be overcome or corrected. A rating of severe indicates that the soil has serious limitations that are difficult to overcome. A severe rating, however, does not mean that the soil cannot be used for the specific use.

Discussed in the following paragraphs are the properties considered in rating the limitations to each of the uses given in table 8.

Disposal of effluent from septic tanks.--Considered in rating the soils according to their limitations to use for disposing of effluent from septic tanks were the depth to the water table, the texture of the soil material, the depth to and kind of bedrock, permeability, rate of percolation, hazard of flooding, the degree of the slope and its effect on the ground water, and the presence of a fragipan.

Sewage lagoons.--Sewage lagoons are ponds built to dispose of sewage through biological decomposition and oxidation. Considered in estimating

the ratings given in table 8 were the texture of the soil material, drainage, slope, the hazard of flooding, depth to bedrock, stoniness, and the compaction, permeability, and organic-matter content of the soil.

Dumps and junkyards.--The ratings in table 8 include the need for controlling runoff by diking the lower side of areas used for dumps and junkyards. The degree of the slope on the upper side of the areas was not considered in the ratings, but dumping is easier if the slope is steep. Considered in the ratings were depth and texture of the soil material, drainage, depth to the water table, and the slope.

Earth-covered fallout shelters.--For fallout shelters, at least half of the building should be below the surface and the entire building should have a cover of earth 3 feet thick. The soil properties considered in rating the soils for fallout shelters were depth to bedrock, drainage, the hazard of flooding, depth to the water table, permeability, susceptibility to frost action, stability of the soil, stoniness, and the degree of the slope.

Houses with basements.--The rating in table 8 are for residential buildings that have a basement, or cellar, and where the disposal of sewage effluent is through septic tanks. Considered in the ratings were the hazard of flooding, depth to the water table and to bedrock, drainage, stability of the soil, the presence of a fragipan, stoniness, permeability, and the degree of the slope.

Cemeteries.--The most favorable soils for cemeteries are those that are at least 6 feet deep, do not have a high water table, are not subject to flooding, and do not have rocks and stones on the surface. In considering the use of soils for cemeteries, the depth to bedrock is especially important and an investigation should be made at the site. Considered in the ratings given in table 8 were the hazard of flooding, depth to the water table, to a fragipan, and to bedrock, texture of the soil material, drainage, and the degree of the slope.

Campsites.--These are areas used for tents, camping trailers, and picnics, and as sites for cottages that are used seasonally and where the disposal of sewage effluent is through septic tanks. Properties to consider when selecting campsites are a hazard of flooding, a seasonal high water table, the depth and stability of the soil material, drainage, permeability, stoniness, and the degree of the slope. Wetness affects the degree of limitation for campsites.

Intensive play areas and shooting ranges.--The ratings in table 8 are for soils used for shooting ranges and for school athletic fields and other intensive play areas. Considered in estimating the ratings were the degree of the slope, stoniness, texture of the surface layer, drainage, the hazard of flooding, depth to the water table, erodibility, and wetness.

Golf fairways.--Considered in rating the soils for golf fairways were drainage, the texture and the available moisture capacity of the soil material, depth to the water table and to bedrock, stability, stoniness, and seasonal wetness. Suitability for putting greens was not considered in the ratings.

Unpaved access road and parking areas.--These are unpaved parking areas and dirt, sand, or gravel roads used to carry traffic to and between recreational areas, buildings, and cottage sites. Soil properties considered in the ratings were the degree of the slope, drainage, texture, stoniness, stability, depth to the water table, susceptibility to frost action, and the hazard of flooding.

Ski areas.--The ratings in table 8 are for areas that can be developed and maintained for skiing when the ground is frozen and covered by snow. Considered in the ratings were the degree and length of the slope, stoniness, rockiness, and the erodibility of the soil. The ease or difficulty of maintaining these areas in summer was also considered in the ratings.

Use of Soils for Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table ___ the soils of
are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table ___ the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of slight means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A moderate limitation can be overcome or modified by planning, by design, or by special maintenance. A severe limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry; are free of flooding during the season of use; do not have slopes or stoniness that greatly increases cost of leveling sites or of building access roads.

Paths and trails are used for local and cross country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

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Formation, Morphology and Classification of the Soils

This section discusses the major factors that affect the formation and morphology of the soils of _____ County and classifies the soils by higher categories.

Factors of Soil Formation

Soils are formed through the interaction of five major factors. They are namely: climate, plant and animal life, parent material, relief, and time. The relative influence of each factor usually varies from place to place. Local variations in soils are due to differences in kind of parent material and in topography and drainage. In places one factor may dominate the formation of a soil and determine most of its properties.

Climate

The climate of _____ County is characteristic of a humid continental type that is marked by extreme seasonal temperature changes. It has an annual precipitation of about ___ inches and a mean annual air temperature of about ___ F. The rainfall is rather uniform during the growing season of May through September, averaging about ___ to ___ inches. The cool temperature has promoted the accumulation of organic matter in the surface layers of the soils. For more detailed information on climate, see the climate subsection in the section "Environmental Factors Affecting Soil Use."

Plant and Animal Life

All living organisms are important to soil formation. These include vegetation, animals, bacteria and fungi. The vegetation is generally responsible for the amount of organic matter, color of the surface layers and the amount of nutrients. Animals such as earthworms, cicada and burrowing animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing nutrients for plant food. In _____ County, the native forests have had more influence on soil formation than any other living organism. Man, however, has greatly influenced the surface layers where he has cleared the forests and plowed the land. He has added fertilizers, mixed some of the soil horizons, and has even moved soil materials from place to place.

Parent Materials

Parent material is the unconsolidated masses from which the soils are formed. It also determines the mineralogical and chemical composition of the soil and to a large extent the rate that soil-forming processes take place.

In _____ County, soils have been formed from glacial till, a mixture of glacial till and residuum, glacial outwash, recent stream alluvium and organic materials. Most of the soil materials were left after the glaciers melted 10,000 to 15,000 years ago. Alluvial and organic materials are of recent origin and are being deposited at the present time. Soils formed from glacial till are the most extensive and have a wide range of characteristics. Firm substrata are commonly present. _____, _____, _____, _____ and _____ are a few examples. Examples of soils formed in a mixture of glacial till and residuum are _____, _____, _____, and _____. Soils formed from glacial outwash deposits are generally loamy textured and commonly underlain by stratified sand and gravel. Examples of these soils are _____, _____, and _____. Soils on the stream bottoms are formed from water-laid materials called recent alluvium. They are medium textured and have little or no soil development. Examples of these soils are _____, _____, and _____. Soils that are formed from organic materials are called peat and muck.

Relief

_____ County is in the glaciated part of the Allegheny Plateau of _____. This region is a dissected plateau within the _____ River drainage system. In places the plateau is dissected to depths of several hundred feet. The _____ Valley walls rise sharply to the dissected plateau, in places as much as ____ or ____ feet difference in elevation in less than a mile.

Within the plateau itself, there may be a difference of ____ feet elevation between the top of the plateau and lower elevations. Average elevations over much of the county are between _____ and _____ feet above sea level. Hills adjoining _____ County are _____ to _____ feet or more. Upland slopes are gently rolling over the broad summit areas and side slopes are moderately sloping to steep. About _____ percent of the county is comprised of stream terraces or flood plains. The general features of the upland area have been smoothed by glaciation, giving rise to landscapes with smooth curves rather than sharp, abrupt features.

The shape of the land surface, commonly called the lay of the land; the slope, and the position in relation to the water table have had great influence on the formation of soils in the county. Soils formed on sloping areas where runoff is moderate to rapid generally are well drained, have a bright-colored, unmottled subsoil, and in most places are leached to greater depths than wetter soils in the same general area. In more gently sloping areas where runoff is slower, the soils generally exhibit some evidence of wetness for short periods of time, such as mottling in the subsoil. In level areas or slight depressions where the water table is at or near the surface for long periods, the soils show evidence of wetness to a marked degree. They have dark-colored thick, organic surface layers and strongly mottled or grayish subsoils. Some soils, however, are wet because of a high water table or because of their position. Also, the permeability of the soil material, as well as the length, steepness, and

configuration of the slopes, influence the kind of soil that is formed from place to place. Local differences in soils are largely the result of differences in parent material and topography.

Time

The formation of soils requires time for changes to take place in the parent materials, and this is usually a long time when measured in years. The soils of _____ County have developed in the period since glaciation. Evidence of this relatively limited time can be seen in the soils.

Soils formed on low bottoms, subject to varying degrees of overflow, may receive new sediments with each flooding. These soils have only weak soil structure, and weak color differences between horizons. An example is the _____ soils. Soils that have well developed soil horizons such as _____ have been developing for longer periods than the _____ soils.

Morphology of Soils

This subsection describes briefly horizon nomenclature and the processes involved for horizon development.

Major Soil Horizons

The results of the soil-forming factors can be distinguished by the different layers, or soil horizons, seen in a soil profile. The soil profile extends from the surface of the land downward to materials that are little altered by the soil-forming processes.

Most soils contain three major horizons called A, B and C (25).[2/] These major horizons may be further subdivided by the use of numbers and letters to indicate changes within one horizon. An example would be the B2t horizon which represents a B horizon that contains an accumulation of clay.

The A horizon is the surface layer. An A1 horizon is that part of the surface layer with the largest accumulation of organic matter. The A horizon is also the layer of maximum leaching or eluviation of clay and iron. If considerable leaching has taken place and organic matter has not darkened the material, the horizon is called an A2. In some soils in _____ County the A2 horizon is brownish in color because of the oxidation of iron.

The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation, or illuviation of clay, iron, aluminum, or other compounds, leached from the surface layers. In some soils, the B horizon is formed by alteration in place

rather than by illuviation. The alteration may be caused by oxidation and reduction of iron or by the weathering of clay minerals. The B horizon commonly has blocky or prismatic structure, and it generally is firmer and lighter colored than the A1 horizon, but darker colored than the C horizon.

The C horizon is below the A or B horizon. It consists of materials that are little altered by the soil-forming processes, but may be modified by weathering.

Processes of Soil Horizon Differentiation

In _____ County several processes are involved in the formation of soil horizons. Among these are the accumulation of organic matter, the leaching of soluble salts, the reduction and transfer of iron, the formation of soil structure, and the formation and translocation of clay minerals. These processes are continually taking place and generally at the same time throughout the profile. Such processes have been going on for thousands of years.

The accumulation and incorporation of organic matter take place with the decomposition of plant residue. These additions darken the surface layer and help to form the A1 horizon. Organic matter, once lost, normally takes a long time to replace. In _____ County the organic matter content of the surface layer averages about ___ percent.

In order for soils to have distinct subsoil horizons, it is believed that some of the lime and other soluble salts are leached before the translocation of clay minerals. Among the factors that affect this leaching are the kinds of salts originally present, the depth to which the soil solution percolates, and the texture of the soil profile.

Well drained and moderately well drained soils in _____ County have yellowish-brown or reddish-brown subsoil horizons. These colors are caused mainly by thin coatings of iron oxides on sand and silt grains; although, in some soils like the _____, the colors are inherited from the reddish glacial materials in which they developed. Weak to moderate development of subangular blocky structure has taken place, but the subsoils contain little or no more clay than the overlying surface horizons.

A fragipan has developed in the subsoil of most of the moderately well and somewhat poorly drained soils in the county. These horizons are very firm and brittle when moist, and they are very hard when dry. Soil particles are tightly packed so that bulk density is high and pore space

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2/ Add to Literature Cited Section:
(25) United States Department of Agriculture
1951. Soil Survey Manual, U.S. Dept. of Agr. Handbook No. 18, 503 pp., illus.

is low. Genesis of these horizons is not fully understood, but studies show that swelling and shrinking takes place in alternating wet and dry periods. This may account for the packing of soil particles and also for a gross polygonal pattern of cracks in the fragipan. Clay, silica, and oxides of aluminum are the most likely cementing agents causing brittleness and hardness.

The reduction and transfer of iron is associated mainly with the wetter, more poorly drained soils. This process is called gleying. Moderately well drained to somewhat poorly drained soils have mottles of yellowish-brown and reddish-brown which indicate the segregation of iron. In poorly drained to very poorly drained soils, such as the _____, _____ and _____ soils, the subsoil and underlying materials are grayish colored which indicates reduction and transfer of iron by removal in solution.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode or origin, are grouped. In table / /, the soil series of / / County are placed in / / categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in sol (Ent-i-sol).

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of water-logging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is Aquent (Aqu, meaning water or wet, and ent, from Entisol).

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GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (Hapl, meaning simple horizons, aqu for wetness or water, and ent, from Entisols).

SUBGROUP. Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reactions, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae /see table ___/. An example is the coarse-loamy, siliceous, acid, thermic family of Typic Haplaquents.

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TABLE__--Soil series classified according to the current system of classification and the 1938 system with later revisions

Series	Current classification			1938 system with later revisions
	Family	Subgroup	Order	Great soil group

Hints for Writing Better

Soil Survey Manuscripts

1. Make an outline and follow it.

2. Use the Soil Survey Manual and the Dictionary for proper use of words and terms.

3. Use the common word.

4. Do not use "and/or" and "etc." Write, for example,"the soils are shallow, or rocky, or both."

5. Use formal English in comparisons.

   Informal: John is not as tall as Jim.
   Formal: John is not so tall as Jim.

6. Have only one idea in a sentence.

7. Use parallel terms and words.

   Wrong: The soils in the uplands are silty, clayey, and loamy sand.
   Right: The soils in the uplands are loamy, clayey and sandy.

8. Be specific.

   Wrong: The subsoil contains more clay.
   Right: The subsoil contains more clay than the surface layer.

9. Excessive use of "land" can be confusing. It has many meanings.

10. Use present tense rather than the future.

    Wrong: The subsoil will be silt loam.
    Right: The subsoil is silt loam.

11. Avoid using "a" too many times.

    Wrong: The surface layer is a silt loam.
    Right: The surface layer is silt loam.

12. Use "the" with a river but not with a creek.

    "Beaver Creek is a tributary of the Cedar River."

13. Locate figure reference in proper place in text.

14. We prefer some term other than "recommend" for things or actions.

15. Use PLACE words rather than TIME words.

    Wrong: The subsoil may be calcareous.
    Right: The subsoil is calcareous in some places.

16. Use "ranges" and "varies" properly.

Wrong: The texture ranges from clay loam to silty clay loam.
Right: The texture is clay loam or silty clay loam.
Wrong: The texture varios from sandy loam to silty clay loam.
Right: The texture ranges from sandy loam to silty clay loam.

17. Avoid using "found."

Wrong: The Webster soils are found in the northern part of the county.
Right: The Webster soils are in the northern part of the county.

18. Use "fine" and "coarse" in place of "heavy" and "light" unless used as a modifier.

Wrong: The heavy subsoil is slowly permeable.
Right: The fine textured subsoil is slowly permeable.
Right: The subsoil is light silty clay loam.

19. Use "hazards" and "limitations" correctly.

20. Use "problems" and "solutions" correctly.

Wetness is a problem--drainage is a solution.

21. Soils in their natural state are "suited"--not "adapted."

22. Use "can" rather than "may."

23. Give proper location of detailed profile description. Avoid quarter corners and man-made objects.

24. Give thickness of last horizon in detailed profile description.

25. In mapping units give important inclusions.

26. In the paragraph of comparisons use the series name of the soil being described as the subject of each sentence.

27. Describe each component soil in a complex or association and give the proportion occupied by each.

28. Avoid confusion in giving thickness of horizons.

Wrong: The A horizon is 8 to 16 inches thick. The B horizon is 12 to 18 inches thick. The C horizon begins at depths of 16 to 40 inches.

29. "Massive" and "single grain" are structureless.

Wrong: The underlying material has a massive structure.
Right: The underlying material is massive.

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